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USARIEM TECHNICAL REPORT T18-05

**LONGITUDINAL VALIDATION OF THE
OCCUPATIONAL PHYSICAL ASSESSMENT TEST (OPAT)**

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Foreword

This Technical Report documents the longitudinal validation of the Occupational Physical Assessment Test (OPAT) in recruits tested prior to and at the end of Initial Entry Training (IET). A number of earlier reports document the initial development and concurrent validation of the OPAT^{1, 2}, as well as the specific requirements of fully trained Soldiers in the seven combat arms MOSs: Infantry (11B and 11C)³, Combat Engineers (12B)⁴, Field Artillery (13B and 13F)⁵, and Armor (19D and 19K)⁶.

List of Acronyms

CMTS	Criterion Measure Task Simulation
FAASV	Field Artillery Ammunition Supply Vehicle
IAR	Interval Aerobic Run
IET	Initial Entry Training
MAPS	Minimal Acceptable Performance Standard
MOS	Military Occupational Specialty
MPAT	Multi-Purpose Anti-Tank
OPAT	Occupational Physical Assessment Test
PDS	Physical Demands Study
PPE	Personal Protective Equipment
SDL	Strength Deadlift
SLJ	Standing Long Jump
SME	Subject Matter Expert
SPT	Seated Power Throw
TRADOC	Training and Doctrine Command
USARIEM	U.S. Army Research Institute of Environmental Medicine

BACKGROUND

The U.S. Army Research Institute of Environmental Medicine (USARIEM) was tasked by the Training and Doctrine Command (TRADOC) to develop a criterion-based physical testing procedure for entry into seven physically demanding combat arms military occupational specialties (MOSs: 11B Infantryman, 11C Infantryman-Indirect Fire, 12B Combat Engineer, 13B Cannon Crewmember, 13F Fire Support, 19D Cavalry Scout, and 19K Armor Crewman). This tasking resulted from the removal of the Army direct ground combat exclusion rule by the former Secretary of Defense (Mr. Leon Panetta) in January 2013, which required the services to open all MOSs to women or justify the decision to keep them closed.

TRADOC developed a list of 32 critical physically demanding tasks relevant to the combat arms MOSs, such as casualty drag, and reloading a tank. USARIEM then conducted the Physical Demands Study (PDS) that included three research studies. Study 1 was the job analysis that identified and measured the physiological requirements of the physically demanding tasks of each MOS.⁷⁻¹² The most physically demanding tasks of each MOS were identified from these data. Across the seven MOS, there were eight tasks. A criterion measure task simulation (CMTS) was developed for each of the eight tasks, which included elements that replicated the physiological demands of the tasks. Study 2 determined the reliability of the CMTSs. Finally, predictor test batteries using cost-, space-, and time-efficient physical fitness tests were developed in Study 3 to screen recruits into the combat arms MOSs. The results of each MOS studied were documented in separate technical reports.³⁻⁶ A final report detailed the development of the Occupational Physical Assessment Test (OPAT) used to select recruits into all seven combat arms MOSs.^{1, 2} The OPAT is comprised of four physical test items including the standing long jump, the seated power throw, the strength deadlift, and the interval aerobic run.

TRADOC Center for Initial Military Training (CIMT) is responsible for setting the cut-scores for each OPAT test item. The term “cut-score” (or “cut-off score”) refers to the lowest possible score on the OPAT that a recruit must earn to be eligible to ship for training in an MOS. This score indicates the recruit has the physical potential to be trained to perform the physically demanding tasks of the MOS. To ensure Soldiers are capable of performing all the CMTSs, recruits must meet the minimum score on each OPAT test event to begin training in an MOS. The test event with the lowest performance level dictates the overall OPAT level achieved. Because the standards are based on the task requirements, all standards are independent of sex and age. All recruits are required to meet the same cut-score to begin training for an MOS.

To help identify appropriate cut-scores, USARIEM developed contingency tables. The tables show the percentage of soldiers who pass the CMTSs for each OPAT test event score. The tables provided a basis for selecting scores that would maximize the number of Soldiers who would successfully complete the CMTSs required of their MOS by the end of IET, while identifying Soldiers who would not be able to successfully perform the CMTSs. Because the data from the PDS were from operational (i.e., fully-trained) Soldiers, the cut-scores were adjusted for expected improvement in fitness

during IET. The contingency tables and cut-score recommendations were provided to the CIMT, who also considered the standards used by other nations (i.e., Australia, Great Britain and Canada) in setting the OPAT cut-scores. The cut-scores were approved by TRADOC as well as the Department of the Army.

Chief of Staff of the Army, General Mark Milley, determined the OPAT would be used in the recruiting stations to screen all incoming recruits (not limited to combat arms MOSs) to assign them to an MOS for which they had the necessary physical aptitude. To accommodate this order, TRADOC utilized a similar process as was conducted for the combat arms MOSs to define the critical tasks and cut-scores for the additional MOSs. They tasked subject matter experts (SMEs) from each MOS to determine the critical physically demanding tasks of their MOS. TRADOC identified three categorical levels of physical demands for MOSs, namely heavy (or **Black**, which includes all seven combat arms MOSs), significant (or **Gray**) and moderate (or **Gold**) physical demands. Leaders from each MOS determined which category was most appropriate for the MOS based on the SME identified physically demanding tasks. The heavy or **Black** category standards were based on the data collected for the combat arms MOSs. TRADOC set the initial OPAT score 10% lower than the **Black** category for the **Gray** category MOSs and 10% lower than the **Gray** category for the **Gold** category MOSs. Applicants who scored below the Gold level were deemed **White** category, or 'not yet ready to begin training.' These applicants are instructed to physically train on their own or with the recruiter before returning to retest. The category definitions and required cut-scores are listed in Table 1.

Active duty Soldiers were used in all three phases in the PDS; however, the intent of the OPAT is to test new recruits for entrance into the Army. In order to ensure the OPAT would correctly identify new recruits with the potential to perform the physically demanding tasks of their jobs, an additional study was conducted to validate the OPAT in new recruits.

Table 1. TRADOC determined performance cut-scores for the OPAT events.

Physical Demand Level*	Standing Long Jump Cut-Score	Seated Power Throw Cut-Score	Strength Deadlift Cut-Score	Interval Run Cut-Score (level-shuttle #)
Black (Heavy)	160cm 5'3"	450cm 14'9"	160lbs	43 Shuttles (6-2)
Gray (Significant)	140cm 4'7"	400cm 13'1"	140lbs	40 Shuttles (5-8)
Gold (Moderate)	120cm 3'11"	350cm 11'6"	120lbs	36 Shuttles (5-4)
White (Not ready to ship)	Any event score below Gold (Moderate) level			

*Black/Heavy: Frequently/constantly lift 41 lbs. and above or and frequent/constant tasks of 100 lbs. or more with occasional tasks over 100 lb.

Gray/Significant: Frequently/constantly lift 41-99 lbs. with or without occasional tasks up to 100 lb.

Gold/Moderate: Frequently/constantly lifts up to 40 lbs. with or when all physical tasks are occasional.

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DISCLAIMERS

Portions of this technical report have been previously reported.^{1, 3-6}

The opinions or assertions contained herein are the private views of the author(s) and are not to be construed as official or as reflecting the views of the Army or the Department of Defense.

The investigators have adhered to the policies for protection of human subjects as prescribed in Army Regulation 70-25, and the research was conducted in adherence with the provisions of 32 CFR Part 219.

This research was supported in part by appointments to the Postgraduate Research Participation Program at the U.S. Army Research Institute of Environmental Medicine administered by the Oak Ridge Institute for Science and Education.

EXECUTIVE SUMMARY

Purpose

The purpose of this study was to longitudinally validate the Occupational Physical Assessment Test (OPAT) testing procedures in new recruits. The OPAT test was administered at the start of initial entry training (IET) and the criterion measure task simulations (CMTSS) were performed near the end of IET.

Methods

A total of 1,181 recruits (948 men, 233 women) completed the OPAT within the first two weeks of starting IET and 741 (608 men, 133 women) returned to perform the CMTSS within five weeks of completion of IET. The men were training for one of seven combat arms military occupational specialties (MOSs): Infantryman (11B), Indirect Infantryman (11C), Combat Engineer (12B), Cannon Crewmember (13B), Fire Support Specialist (13F), Cavalry Scout (19D), and Armor Crewman (19K). Most of the women were recruited from other physically demanding MOSs (e.g., 31B Military Police, 74D Chemical, Biological, Radiological and Nuclear Specialist). The four OPAT tests are the standing long jump, the seated power throw, the strength deadlift, and the interval aerobic run. The same CMTSS were identified for five of the MOSs (11B, 11C, 12B, 13F, and 19D), so these MOSs were analyzed as one group, and are referred to as Common Task MOSs. The CMTSS included a tactical foot movement, casualty drag, casualty evacuation from a vehicle turret, sandbag carry to build a fighting position, moving under direct fire, loading a Field Artillery ammunition supply vehicle, reloading a tank, and loading the main gun on a tank. Regression analyses were conducted to predict performance on the CMTSS from the OPAT scores.

Results

Regression analyses resulted in coefficients of determination (R^2) of the OPAT's ability to predict job performance scores of 0.77 for the Common Task MOSs, 0.62 for the 13B, and 0.72 for the 19K ($p < 0.01$ for all). When the average job performance score was used to include all seven MOSs in the same regression analysis, the ability of the OPAT to predict performance for all seven MOSs resulted in a validity coefficient (R^2) of 0.70 ($p < 0.01$). When the regression analyses were run separately for men and women the coefficients of determination were greatly reduced from the full sample analyses, but more so in men (range of $R^2 = 0.33-0.48$) than in women (range of $R^2 = 0.42-0.60$). The OPAT scores for recruits who were on course to graduate with their class 10 weeks into IET tended to be higher than the scores of recruits who were not on track to graduate with their class. The Training and Doctrine Command (TRADOC) has identified OPAT scores needed to qualify for a combat arms MOS (Black category). Correct identification of passing/failing Soldiers based on these TRADOC standards was 76% for all MOS groups combined, 78% for the Common Task MOSs, 77% for the 13B, and 73% for the 19K. The injury and Army Physical Fitness data for these Soldiers will be reported elsewhere. In addition, the soldiers will be tracked for injury and attrition for the first two years of their Army career. These results will also be reported in a later report.

Conclusion

The four event OPAT test battery correctly identified 76% of new recruits who were able to perform the physically demanding tasks of their assigned combat arms MOSs by the end of IET, accounting for over 62% of the variance in CMTS performance.

INTRODUCTION

Pre-employment screening is used to select qualified employees for physically demanding occupations such as corrections officers¹³ and fire-fighters.¹⁴ Many military organizations also utilize some form of pre-employment screening. For example, the British Army requires recruits to lift a weighted bag to a height of 1.45 m, carry 20-kg water cans and perform a 2.4-km run to qualify for a specific job.¹⁵ The Australian Army requires Soldiers to pass the 20-m Multi-Stage Fitness Test (“beep test”), push-ups and sit ups to a required standard for entrance, while trained Soldiers must pass occupational-specific performance standards after assignment to an occupation.¹⁶ The U.S. Army implemented a pre-enlistment screening test called the Occupational Physical Assessment Test (OPAT) for all recruits beginning January 2017.¹⁷

The U.S. Army conducted a multi-year research study following Federal guidelines¹⁸ and accepted best practices¹⁹ to identify physical fitness tests which best predict performance on physically demanding tasks of seven combat arms military occupational specialties (MOSs). The MOSs included 11B Infantryman, 11C Infantryman-Indirect Fire, 12B Combat Engineer, 13B Cannon Crewmember, 13F Fire Support, 19D Cavalry Scout, and 19K Armor Crewman. Using job analysis procedures, a group of eight criterion measure task simulations (CMTSs) were identified for the seven MOSs: tactical foot march, build a fighting position with sandbags, move under direct fire, evacuate a casualty from a vehicle, drag a casualty to safety, reload a Field Artillery ammunition supply vehicle (FAASV), reload the Abrams tank, and fire the main gun on an Abrams tank. Five of the MOSs had a common set of CMTSs (11B, 11C, 12B, 13F and 19D) and are collectively referred to herein as the “Common Task MOSs.” Two MOSs (13B and 19K) had CMTSs that were unique to each job (Table 2).

Table 2. Most physically demanding tasks by task type for each of the seven combat arms MOSs.

	11B, 11C, 12B, 13F, 19D (Common Task MOSs)	13B	19K
Load Carriage	Foot March		Foot March
Repeated Lift and Carry	Prepare a Fighting Position	Transfer Ammo with a FAASV	Stow Ammo on an Abrams
Heavy Drag	Casualty Drag	Casualty Drag	Casualty Drag
Heavy Lift	Casualty Evacuation	Transfer Ammo with a FAASV	Casualty Evacuation
Controlled Heavy Transfer			Load Main Gun on an Abrams
Agility	Move Under Direct Fire		Move Under Direct Fire

Grayed cells indicate MOS(s) had no task in that physical domain.

The 14 field-expedient tests initially considered to predict CMTS performance (“predictor tests”) included measures of muscular strength, muscular endurance, muscular power, aerobic capacity, and agility (see Appendix Table A1 for list of all tests). Fully trained Soldiers performed the CMTSs of a specific MOS as well as the 14 physical fitness predictor tests. A series of regression analyses were conducted to predict performance of the CMTSs from the predictor tests. A set of four physical fitness predictor tests (called the Occupational Physical Assessment Test) were selected that best predict CMTS performance for all seven combat arms MOSs.^{1, 2} The four event OPAT consists of the standing long jump (SLJ) to measure lower-body power, seated power throw (SPT) to measure upper-body power, the strength deadlift (SDL) to measure lower-body strength, and the interval aerobic run (IAR) to measure aerobic capacity. All research to select the OPAT predictor tests (known as the Physical Demands Study) was conducted on fully trained men in the combat arms MOSs and fully trained women from MOSs with comparable high physical demands.^{1, 2} Women were recruited from other MOSs because there were no women serving in these combat arms jobs at the time. Further, at the time of the previous research, trained Soldiers performed both the OPAT and the CMTSs within a two-week period (concurrent validation), whereas the OPAT was not required prior to Initial Entry Training (IET). In order to ensure the OPAT accurately predicted the performance of new recruits at the end IET, it was essential to conduct a predictive or longitudinal validation study. Thus, the purpose of this study was to establish the longitudinal validity of the OPAT testing procedures in new recruits, using a predictive study design in which the OPAT was administered at the start of IET and the CMTSs were assessed near the end of IET. This report also evaluated the accuracy of the OPAT cut-scores set by the Training and Doctrine Command (TRADOC) for entrance into the seven combat arms MOSs. The secondary objectives include examining the associations of OPAT test scores with hardiness, injury history, the Army Physical Fitness Test, and on-time graduation. Additionally, recruits will be tracked for their first two years of active duty service to examine the relationships between the OPAT and CMTSs with injury/medical history and service status within their MOS. The data from these secondary objectives will be presented in other publications.

METHODS

Data were collected from recruits during 27 field studies from January 2016 to December 2016. Field studies were conducted at the following IET sites: Ft. Benning, GA (Infantry and Armor, men only); Ft. Sill, OK (Field Artillery men and women, plus women from other MOSs) and Ft. Leonard-Wood, MO (Combat Engineer men and women, plus women from other MOSs). Recruits were briefed on all of the testing requirements and signed a consent form prior to participation. A detailed testing schedule is provided in Appendix Table B1.

Recruits (n=1181; 948 men, 233 women) completed the OPAT within the first two weeks of starting IET. A total of 741 recruits (608 men, 133 women) returned to

perform the CMTSs within five weeks of completion of IET, and, thus, had both OPAT and CMTS performance data. Men were training for the MOS being tested, whereas most of the women were recruited from other physically demanding MOSs (e.g., 31B Military Police, 74D Chemical, Biological, Radiological and Nuclear Specialist). It should be noted that many women performed the CMTSs for more than one MOS. For example, the Common Task MOS CMTSs plus the 13B MOS CMTSs.

TESTING OVERVIEW

Testing consisted of four OPAT events measured during the first two weeks of IET and two to six CMTSs for each MOS measured near the end of IET (within 5 weeks of graduation; roughly 10-16 weeks after OPAT testing). Recruits were placed in 6 to 10 person squads and completed all testing as part of that squad. Participants completed an information sheet that contained demographics and task performance history, as well as a survey of recent injuries. Height and body mass were collected before OPAT testing with recruits in the Army physical training uniform (APFU; t-shirt, shorts, sneakers). Body mass was measured prior to CMTS testing in each uniform configuration needed (e.g., body armor, helmets, weapon). Prior to each test, recruits were briefed and familiarized with the procedures.

TESTING PROCEDURES

OPAT Events:

Recruits performed all OPAT testing within the first two weeks of beginning IET. Most testing was conducted while recruits were still in the reception station, prior to beginning IET, while wearing the APFU. All OPAT events were completed on the same day. Recruits were divided into groups of 10. Each group was randomly assigned to one of three stations (standing long jump, seated power throw, and strength deadlift) and rotated through each station as a group. Each group then performed the interval aerobic run last. Detailed OPAT testing instructions followed during this study are included in Appendix C.

Standing Long Jump (SLJ)

Recruits began the test standing behind a line marked on a broad jump mat (Sportime 22x144 in Standing Long Jump Test Mat, Sport Books Publisher, Niagara Falls, NY) with feet slightly apart. A two-foot take-off and landing was used with swinging of the arms (countermovement) and bending of the knees to provide forward drive. Recruits were instructed to jump as far as possible, landing on both feet without falling backwards. The distance of the jump was measured from the starting line to the back of the recruit's feet. Three trials were conducted, with roughly 30 seconds of rest between trials. The two furthest jumps were averaged to determine an overall score.²⁰

Seated Power Throw (SPT)

Recruits began the test in a seated position on the floor with their legs straight out and slightly apart in front of them. Recruits held a 2-kg medicine ball with both hands. On command, the recruit touched the ball to their chest and pushed/putted the ball at a 45-degree angle as far forward as possible. The distance between the landing point and the wall was measured. Recruits were given two practices and three recorded trials, with roughly 30 seconds of rest between trials. The distance of each trial was recorded. If there was more than a 10% difference between the three scores, they were given up to two additional trials. The two highest trials were averaged to determine an overall score. During the current study, recruits were seated on the floor with a yoga block placed at their lower back to help prevent the shoulders from moving away from the wall; however, during the PDS, Soldiers were seated in a straight back chair for the test.²¹ Based on a mechanical analysis with all variables staying the same except for the starting point of the throw, the difference in distance thrown is approximately 2.5% lower for floor sitting than for chair sitting.

Strength Deadlift (SDL)

Recruits began the strength deadlift test in a standing position with their feet shoulder-width apart. They squatted down to grasp the handles of the barbell at their sides, and lifted the barbell to a full standing position. The strength deadlift was performed using hexagon barbells (Rogue TB-2 Trap Bar, Columbus, OH) and standard weighted bumper plates (Diamond Pro Bumper Plates, Decatur, AL). The loads lifted were 60-, 100-, 140-, 180-, and 220 lbs. (a range of 27.3 kg-100 kg). The recruits were given instructions on proper lifting technique prior to beginning the test. The starting weight was 60 lbs. (27.3 kg) with recruits completing three lifts at this weight to warm up and practice a safe lifting technique. The weight was increased by 40 lbs. (18.2 kg) with each subsequent single lift, with one minute of rest between lifts. This was repeated until the recruit had reached the heaviest weight they could lift, up to a maximum weight of 220 lbs. (100 kg). Study team members ensured proper lifting technique was maintained (e.g., head and back neutral, chest up, and straight arms). If recruits displayed poor form during the lift (e.g., rounded back, head looking up or down, or knees caving in/knocked knees), they were not permitted to lift more weight. The heaviest weight lifted with correct form was recorded. During the PDS, Soldiers performed the deadlift using sets of dumbbells raised to the level of a standard weight lifting bar (8 inches). In addition, the weight was increased by 20 lbs. (9.1 kg) with each lift instead of the current 40-lb (18.2-kg) increase. The difference in lifting strength due to the change in equipment has not been determined.

Interval Aerobic Run (IAR)

Recruits began by standing behind the starting line, facing a second line 20 meters away. When instructed by a recording, recruits began running at a slow pace back and forth between the two lines. Recruits continued running between the two lines, placing at least one foot on the opposite line and turning when signaled by the recorded beeps. After each minute, a different tone indicated an increase in speed, and the beeps sounded closer together. If the line was not reached before the beep sounded, the recruit was given a warning. They were expected to finish running to the line, turn and catch up with the pace within two more 'beeps.' The test was stopped when the recruit failed to reach the line for two consecutive beeps after missing the first beep or when the recruit voluntarily stopped. The total number of shuttles successfully completed (reached the line prior to the beep) was recorded.²² During the PDS, Soldiers wore a heart rate monitor to objectively measure near-maximal effort. The OPAT recruits did not wear a heart rate monitor, so the level of effort cannot be objectively confirmed. In both the current study and PDS, the IAR was always performed last.

Criterion Measure Task Simulations:

Recruits performed all MOS appropriate CMTSs within five weeks of completing IET. The uniform worn (defined by the subject matter experts or SMEs) varies with the task and is listed in the detailed testing procedures in Appendices D1 and D2, respectively. All men were trained during IET to perform the common soldiering tasks and MOS-specific tasks. Women were also trained on common soldiering tasks during IET and were provided additional instruction and training by SMEs from the appropriate schools on the 13B and 19K MOS-specific tasks.²³ The Common Task MOSs (i.e., 11B, 11C, 12B, 13F, and 19D) shared the same five critical tasks (i.e., tactical movement, sandbag carry, move under direct fire, casualty evacuation, and casualty drag). These MOSs with common CMTSs were statistically treated as one and are referred to as the "Common Task MOSs". The 13B and 19K MOSs had CMTSs that were specific to the MOS and, thus, were treated separately from the Common Task MOSs. The minimum acceptable performance standard (MAPS) for each CMTS was established by TRADOC SMEs during the PDS, and were applied to recruit performance in this study.

Conduct a Tactical Movement (MOSs performing 11B, 11C, 12B, 13F, 19D, 19K)

The foot march simulation required recruits to complete a four-mile walk while wearing the basic Soldier uniform, personal protective equipment (PPE) without body armor, a simulated weapon, and a 24-hour (33 lbs./15 kg) sustainment load (~70 lbs./32 kg, skin-out). The load carried by the recruits in this study was less than that carried during the PDS (~103 lbs./47 kg, skin-out) at the request of the Infantry School due to concerns about potential injuries in recruits. All participants were instructed to complete

the task as quickly as possible while walking on a supervised course. Running and the 'airborne shuffle' were not allowed. Participants were allowed to rest as needed. Participants were instrumented with a timing chip (SPORTident Model SIAC1, Arnstadt, Germany). Time to completion was recorded. The MAPS was 107 minutes.

Prepare a Fighting Position: Sandbag Carry (11B, 11C, 12B, 13F, 19D)

The sandbag carry test required recruits to lift and carry 16 sandbags to build a fighting position, while wearing a fighting load minus the weapon (approximately 71 lbs./32.3 kg). The 40-lb (18.2 kg) sandbags were carried 10 meters and placed on the floor in a 4 bags long x 2 bags deep x 2 bags high position as quickly as possible. Recruits were permitted to carry up to two bags at once. Time to complete the task was collected. The MAPS was 8 minutes.

Move Under Direct Fire (11B, 11C, 12B, 13F, 19D, 19K)

The move under direct fire task required recruits to rush from marker to marker, placed 6.6 meters apart, while assuming alternating kneeling or prone positions. Recruits wore a fighting load (approximately 83 lbs/38 kg) and carried a simulated weapon at the ready. Recruits began the task in the prone position. Upon command, they rose, sprinted 6.6 meters to the next marker and assumed the predetermined position for that marker (either a kneeling or prone position). They remained in this position for 5 seconds. Upon signal, participants rose, sprinted to the next marker and assumed the next predetermined position for that marker. The cycled order of the positions was kneel, kneel, prone. This was repeated until the recruit completed a total of 100 meters (15 rushes). Participants were instructed to move as quickly as possible across the finish line. Time to complete the task was recorded. The MAPS was as fast as possible.

Casualty Evacuation from a Vehicle Turret (11B, 11C, 12B, 13F, 19D, 19K)

The casualty evacuation task required recruits to pull a casualty from a vehicle through an overhead hatch. This task was simulated using a platform with a hole designed to simulate the hatch of an M1 Abrams tank. Participants wore a fighting load minus the weapon (approximately 71 lbs./32.3 kg). A haul bag (Black Diamond Zion, Salt Lake City, UT) was used to simulate a casualty. The bag was modified to include the shoulder straps of a Combat Vehicle Crewman protective vest.

The bag was placed in the platform hole with the handles of the bag level with the platform (see Figure 1a). The platform had a series of five holes with bags weighing 60, 100, 140, 180 and 220 lb. Recruits started with the 60 lbs. bag and moved to the next heavier bag with each successful lift. Prior to initiating the task, each recruit practiced proper lifting technique using a pair of 25-lb (11.4-kg) kettlebells. They

climbed onto the platform, squatted and grasped the handles of the heavy bag, and stood up while pulling the bag through the hole in the platform (see Figure 1b). Recruits were required to place the heavy bag onto the platform for successful task completion. If recruits were not able to lift the bag with correct form, they were allowed a second try following a short rest. The maximum successful load lifted was recorded. The MAPS was 100 lbs. (45.5 kg). During the PDS, this test was conducted with self-selected increases in weight, rather than the set increases used here. However, the range of weights lifted during the PDS was the same (60-220 lbs.) as used in the current study. This self-selection of loads during the PDS likely increased the number of lifts performed and may have resulted in a submaximal performance for some volunteers.

Figure 1a. The starting position for the casualty evacuation task.



Figure 1b. Participants performing the casualty evacuation task by pulling the haul bag through the hole of the platform.



Drag a Casualty to Immediate Safety (11B, 11C, 12B, 13B, 13F, 19D, 19K)

The casualty drag task required recruits to drag a simulated casualty (approximately 270 lbs./122.7 kg) 15 meters as fast as possible with an upper limit of 60 seconds while wearing a fighting load with a weapon (approximately 83 lbs./38 kg). For the simulated casualty, a Survivor dummy (Dummies Unlimited, Pomona, CA) was modified to obtain the necessary weight (Figure 2). If the participant failed to pull the casualty 15 meters in 60 seconds, the distance the casualty was dragged was measured. A rubber flooring (4' x 6' x 3/4" Interlocking Diamond Plate Tiles, Kodiak Sports, Plano, TX) was used as a standardized surface for testing. Scores were calculated as the velocity ($\text{m}\cdot\text{s}^{-1}$) at which the dummy was moved. The MAPS was 15 meters in 60 seconds.

Figure 2. Participant performing the casualty drag task using a simulated casualty.



Transfer Ammunition into an M992 Field Artillery Ammunition Supply Vehicle (FAASV) (13B)

The transfer ammunition task required recruits to move heavy rounds from the floor to an ammunition rack inside a FAASV, while wearing approximately 49 lbs. (22.3 kg) of task-specific equipment. Recruits had 20 minutes to lift 30, M795 155-mm high-explosive rounds (approximately 100 lbs./45.5 kg each) from the tailgate of the FAASV, carry them 3-m and place them into the designated locations on the ammunition rack inside the FAASV. The highest point on the rack that the participant was required to place the round was equal to shoulder height. Participants were given openings lower on the rack to make up for any that were above their shoulder height (see Figure 3). The 21 minutes were divided into three 5-minute active loading periods with two 3-minute rest periods. Time to complete the task (not including the 3-minute rest period)

was recorded. If the participant was actively moving a round at the end of the 5-minute active loading period, he or she was asked to put it down, and resume loading from where the round was placed during the next active period.

The rate of loading (rounds/min) was calculated either by dividing 30 rounds by the elapsed time (if all rounds were loaded before time expired) or by dividing the number of completed rounds by 15 minutes (if all rounds were not completed in 15 min). The MAPS was 30 rounds in 15 minutes or 2 rounds·min⁻¹.

Figure 3. Participant performing the FAASV simulation task.



Load the 120-mm Main Gun on an Abrams Tank (19K)

The load the main gun task required recruits to load rounds into a simulated main gun. While wearing 49 lbs. (22.2 kg) of task-specific equipment, participants loaded five 120-mm multi-purpose anti-tank (MPAT) rounds (approximately 55 lbs/25 kg each) into a simulated Abrams tank main gun breach as quickly as possible (see Figure 4). Prior to testing, participants were briefed on proper technique and provided an opportunity to practice. Recruits then completed the task three times. Time to complete the task was recorded and the fastest two trials were averaged. The MAPS was five rounds in 35 seconds or 7 sec·round⁻¹.

Figure 4. Layout of the Load the Main Gun simulation task.



Stow Ammunition on Abrams Tank (19K)

The stow ammunition task required participants to move rounds onto a simulated Abrams tank deck. While wearing a fighting load minus the weapon (approximately 71 lbs/32.3 kg), participants moved 18, 120-mm MPAT rounds (approximately 55 lbs/25 kg each) from a rack simulating an ammunition point onto a platform simulating the deck of an Abrams tank (diagram in Figure 5). This platform was 5-meters away from the ammunition rack and required a 64-inch (163-cm) lift. An assistant was standing behind the platform to receive the round. Time to complete the task was recorded, and a rate (rounds/min) of loading the rounds was calculated. If a participant was unable to complete the task within 15 minutes or chose to stop, the rate was calculated as the number of rounds completed divided by 15. The MAPS was to complete 18 rounds in 10 minutes or 1.8 rounds·min⁻¹.

Figure 5. Layout of the Stow Ammunition simulation task.



STATISTICAL ANALYSES

All statistics were calculated using SPSS for Windows Version 24 (IBM Corporation, Armonk, New York). Significance was set at the $p < 0.05$ level. Means and standard deviations (means \pm SD) and ranges are provided, unless otherwise indicated.

Descriptive statistics were calculated for the total group, by sex and by MOS for subject characteristics as well as for each of the OPAT and CMTS variables. To determine if there was a difference in participant characteristics and OPAT scores between recruits who completed post testing and those who did not, a series of two-factor (sex by completion group) analysis of variances (ANOVAs) were run.

The relationship between subject descriptors, OPAT test items and performance of the CMTSs were analyzed using Pearson product-moment correlations for the entire sample, and for women and men separately.

The TRADOC determined MAPS were used to determine if a recruit performed each CMTS to standard. Chi-square analyses were used to determine the differences in passing rates by sex.

To determine the validity of the model, CMTS scores were converted to z-scores to create a common scale for all criterion tasks. The additive inverse (i.e., multiplied by -1) of the z-scores for the tactical movement, sandbag carry, move under direct fire, and load the main gun was used so that better scores were always greater numbers. For each individual, the z-scores for all CMTSs of their MOS were summed to create a total job performance score. Multiple regression models were used to determine the predictive power of the four OPAT events on the total job performance scores of the Common Task MOSs, 13B, and 19K, respectively. The job performance score was then divided by the number of CMTSs for that MOS to create an average job performance score that could be used to assess all seven MOSs at once. A final regression model was used to determine the predictive power of the four OPAT events on the average job performance scores of the seven MOSs combined.

To assess the accuracy of the TRADOC determined cut-scores for the heavy physical demand (or Black) level, contingency tables were used to identify the percentage of individuals who passed the OPAT at the Black level and completed all of the CMTSs of their MOS to standard (true pass). Individuals who failed the OPAT, but passed the MAPS for the CMTSs of their MOS were considered false failures. Those who passed the OPAT, but did not complete all CMTSs to standard were false passes.

Adverse impact towards women was assessed in two ways. First through calculating the female:male (F:M) ratios for passing the OPAT at the Black level and completing all CMTSs to standard. Second, a sex moderated regression analysis was used to determine if the slopes of the regressions of the OPAT events on the average job performance score were different by sex.

A two-way ANOVA was used to determine if the initial OPAT score differed between men and women who were scheduled to graduate with their class at 10 weeks into IET and those who were not. This time point was selected because it is the time period of the basic combat training portion of IET and it can reasonably be assumed that all recruits had a similar exposure to physically demanding activities. Two-way ANOVAs were also used to examine differences between fully trained Soldiers (PDS sample) and new recruits (OPAT sample) in performance of the OPAT events and CMTSSs.

RESULTS

SUBJECTS

Recruit characteristics (i.e., age, height, body mass) are provided in Table 3 for recruits completing the OPAT and for recruits completing both the OPAT and the CMTSSs for at least one MOS. In total, 1181 recruits (948 men, 233 women) completed the OPAT battery at the beginning of IET. Of the 1181 who completed the OPAT, 741 recruits (608 men, 133 women) also completed of the CMTSSs of at least one MOS. 440 (36% of men and 43% of women) were lost to follow-up due to attrition from training, injury profile, voluntary withdrawal from the study, or lack of availability on the day of testing. Men were older, taller and heavier than women; however, there were no differences in the characteristics between those who only completed the OPAT and those who completed both the OPAT and CMTSSs ($p \geq 0.60$).

Table 3. Participant characteristics (Mean \pm SD, *range*) for men and women who completed only the OPAT events compared to those who completed the OPAT events and CMTSSs.

	Completed OPAT only (n=1181)		Completed OPAT and CMTSSs for at least one MOS (n=741)	
	Men (n=948)	Women (n=233)	Men (n=608)	Women (n=133)
Age, years	20.8 \pm 3.1* 17-34	20.4 \pm 2.9 17-33	20.7 \pm 3.1* 17-34	20.2 \pm 2.8 17-30
Height, cm	175 \pm 7* 158-196	163 \pm 6 147-177	176 \pm 6* 158-196	163 \pm 6 151-177
Mass, kg	78.6 \pm 13.0* 47.0-125.6	63.1 \pm 8.3 43.0-83.7	78.8 \pm 12.7* 47.3-125.6	62.8 \pm 8.6 43.0-83.7

* Significant difference by sex ($p < 0.05$), there were no significant group differences.

OPAT TESTING

Average scores for all recruits who took the OPAT were 188 ± 35 cm for the SLJ, 551 ± 112 cm for the SPT, 202 ± 33 lbs (92 ± 15 kg) for the SDL, and 50 ± 19 shuttles for the IAR. The OPAT scores for those who performed only the OPAT and those who completed both OPAT and CMTSs testing are listed by sex and group in Table 4. For the subgroup of 741 recruits who completed both OPAT and CMTS testing, average scores measured at the beginning of IET were 192 ± 34 cm for the SLJ, 560 ± 111 cm for the SPT, 205 ± 29 lbs. (93 ± 13 kg) for the SDL, and 53 ± 19 shuttles for the IAR. Men scored higher than women in all events ($p < 0.01$). Recruits who returned for CMTS testing scored 6% higher on the IAR ($p = 0.02$) at the beginning of IET, but there were no differences in the other events ($p \geq 0.13$). The OPAT event scores by MOS (men) and testing location (women) are listed in Appendix Table B2. The percentage of recruits scoring within each of the OPAT physical demand categories by sex are listed in Appendix Table B3.

Table 4. OPAT scores for men and women who completed only the OPAT events compared to those who completed the OPAT events and CMTSs. Pass rates as a percentage of the subgroup are listed.

	Complete OPAT (n=1181)				Complete OPAT and all CMTSs of at least 1 MOS (n=741)			
	Men (n=948)		Women (n=233)		Men (n=608)		Women (n=133)	
	Mean \pm SD Range	Pass Rate	Mean \pm SD Range	Pass Rate	Mean \pm SD Range	Pass Rate	Mean \pm SD Range	Pass Rate
Standing Long Jump, cm	198 \pm 30* 98-285	91%	148 \pm 23 97-230	31%	200 \pm 29* 98-284	92%	152 \pm 24 97-230	29%
Seated Power Throw, cm	593 \pm 81* 375-938	98%	387 \pm 51 288-575	16%	598 \pm 82* 375-938	99%	388 \pm 52 300-575	15%
Strength Deadlift, lbs.	213 \pm 20* 60-220	97%	162 \pm 35 0-220	55%	215 \pm 17* 100-220	97%	163 \pm 33 100-220	55%
Interval Aerobic Run, shuttles	55 \pm 18* 9-112	73%	33 \pm 14† 10-83	21%	57 \pm 17* 9-112	79%	36 \pm 15 12-83	27%
Pass All Events		67%		7%		73%		8%

* Significant difference by sex ($p < 0.05$)

†: Significant difference by group, no group x interaction ($p < 0.05$)

Passing Standards for OPAT Heavy Physical Demand MOS (Black) Level: Standing Long Jump: 160 cm, Seated Power Throw: 450 cm, Strength Deadlift: 160 lbs., Interval Aerobic Run: 43 shuttles

CMTS TESTING

Table 5 contains the scores and pass rates (percentages by sex and group) of the CMTSs for men, women and all recruits combined. There were significant differences by sex for all tasks ($p < 0.01$), with men performing at a higher level than women. All of the recruits who completed CMTS testing performed the foot march, sandbag carry, and move under direct fire to the MAPS. It should be noted that recruits who did not complete the foot march were dropped from the study as there was no way to score an incomplete performance. In addition, the move under direct fire task standard was 'as fast as possible'; therefore, all recruits who completed the task met the MAPS. Women passed at a lower rate than men for all remaining tasks ($p < 0.05$). At least 80% of men completed each of the CMTSs to the MAPS. The passing rates for women varied from 13% to 100%, with women experiencing the greatest difficulty performing to standard on the FAASV (13% pass rate) and the casualty drag (17% pass rate). Of the recruits completing all of the CMTSs for an MOS, 73% (91% of men, 15% of women) completed the Common Task MOSs' CMTSs to standard, 51% (71% of men, 4% of women) completed the 13B CMTSs to standard, and 79% (97% of men, 13% of women) completed the 19K CMTSs to standard.

Table 6 contains the female to male ratio for the individual CMTSs and for the percentage passing each test to MAPS. Women compared least favorably to men on the tasks with high strength demands such as the casualty drag and the FAASV. Women's performance was more comparable to men on tasks with lower strength demands and absolute external loads (foot march F:M=89%, move under fire F:M=85%, and load main gun F:M=81%).

Table 7 lists correlations among body size, OPAT events and CMTSs for all recruits who completed the study. Separate tables for men and women are included in Appendices B4 and B5, respectively. The four OPAT events were correlated with height (range $r = 0.30-0.63$) and with each other (range $r = 0.41-0.66$). When all recruits were combined, the four OPAT events were significantly correlated ($p < 0.01$) with all of the CMTSs (range $r = -0.29-0.75$). These correlations were reduced in single sex analyses (men only range $r = -0.05-0.56$; women only range $r = 0.17-0.63$). For the full sample, the highest correlations were found between the SPT and casualty drag ($r = 0.74$) and the SPT and stow ammunition ($r = 0.75$). The highest correlations for men were found between the SPT and casualty drag ($r = 0.56$) and the SDL and casualty drag ($r = 0.46$). The highest correlations for women were found between the SDL and casualty evacuation ($r = 0.63$) and the SDL and stow ammunition on an Abrams tank ($r = 0.61$).

Table 5. CMTS scores and pass rates by sex.

	Men			Women			Combined		
	n	Mean \pm SD Range	Pass Rate	n	Mean \pm SD Range	Pass Rate	n	Mean \pm SD Range	Pass Rate
Foot March, min	424	65.8 \pm 6.0* 52.3-93.9	100%	74	73.8 \pm 7.7 58.1-98.9	100%	498	67.0 \pm 6.9 52.3-68.9	100%
Sandbag Carry, min	251	2.05 \pm 0.42* 1.43-4.67	100%	80	3.31 \pm 1.20 1.71-8.82	100%	331	2.36 \pm 0.88 1.43-8.82	100%
Move Under Fire, min	424	2.32 \pm 0.21* 1.83-4.06	100%	80	2.74 \pm 0.27 2.17-3.61	100%	504	2.39 \pm 0.27 1.83-4.06	100%
Casualty Evacuation, lbs.	424	188 \pm 34* 60-210	95%†	80	113 \pm 33 60-210	33%	504	176 \pm 43 60-210	85%
Casualty Drag, m·s⁻¹	608	0.73 \pm 0.31* 0.00-1.61	90%†	130	0.14 \pm 0.16 0.00-0.93	17%	738	0.62 \pm 0.36 0.00-1.61	78%
FAASV, rounds·min⁻¹	184	3.09 \pm 1.34* 0.07-6.79	80%†	76	1.05 \pm 0.72 0.00-2.93	13%	260	2.49 \pm 1.51 0.00-6.79	60%
Load Main Gun, sec	173	21.3 \pm 4.3* 14.9-34.7	100%†	48	26.2 \pm 5.5 17.0-46.1	96%	221	22.3 \pm 5.0 14.9-46.1	99%
Stow Ammo, rounds·min⁻¹	173	7.15 \pm 1.6* 2.85-10.80	100%†	49	3.26 \pm 1.70 0.00-6.43	78%	222	6.29 \pm 2.28 0.00-10.80	95%

* $p < 0.05$ score difference by sex. † $p < 0.05$ pass rate difference by sex

Passing Standards: **Foot March:** 107 min (based on a 4 km/hr standard, less a 20% train-up); **Sandbag Carry:** 8 min (2 min per sandbag); **Move Under Fire:** as fast as possible (all Soldiers who complete the task are considered passing); **Casualty Evacuation:** 100 lbs. (based on nearest test increment to ~1/2 of 2-person 207-lb lift standard); **Casualty Drag:** 0.25 m/s, or 15 m in 60 s; **FAASV:** 2 rounds/min or 30 rounds in 15 min; **Load Main Gun:** 5 rounds in 35 s; **Stow Ammo:** 1.8 round/min or 18 rounds in 10 min (based on 36 rounds in 20 min standard)

Table 6. Female to male ratio for CMTS scores and CMTS passing rates.

CMTS	Female/Male Score (%)	Female/Male Pass (%)
Foot march, min^*	89	100
Sandbag Carry, min^*	62	100
Move Under Fire, min^*	85	100
Casualty Evacuation, lbs.	60	35
Casualty Drag, $\text{m}\cdot\text{s}^{-1}$	19	19
FAASV, $\text{rounds}\cdot\text{min}^{-1}$	34	16
Load Main Gun, sec^*	81	96
Stow Ammo, $\text{rounds}\cdot\text{min}^{-1}$	46	78

* The inverse (male to female ratio) is reported for all timed tasks where a lower score is better.

Table 7. Correlations among body size, OPAT events and CMTSs for all recruits who completed the study.

		Height (cm)	Mass (kg)	BMI	IAR (shuttles)	SPT (m)	SLJ (cm)	SDL (lbs.)	Foot march (min)	Sandbag Carry (min)	Move Under Fire (min)	Casualty Evac (lbs.)	Casualty Drag (m/s)	FAASV (rds/min)	Load Main Gun (sec)	Stow Ammo (rds/min)
Height (cm)	r	1	.591**	.113**	.298**	.628**	.414**	.495**	-.414**	-.561**	-.381**	.484**	.571**	.576**	-.380**	.635**
	n	740	740	740	740	740	740	740	497	330	503	503	737	260	221	222
Mass (kg)	r	.591**	1	.864**	.003	.618**	.166**	.498**	-.276**	-.527**	-.240**	.558**	.572**	.567**	-.414**	.624**
	n	740	741	740	741	741	741	741	498	331	504	504	738	260	221	222
BMI	r	.113**	.864**	1	-.171**	.381**	-.043	.329**	-.101*	-.330**	-.081	.416**	.360**	.324**	-.328**	.453**
	n	740	740	740	740	740	740	740	497	330	503	503	737	260	221	222
Interval Aerobic	r	.298**	.003	-.171**	1	.408**	.561**	.409**	-.418**	-.468**	-.484**	.413**	.412**	.455**	-.285**	.362**
Run (shuttles)	n	740	741	740	741	741	741	741	498	331	504	504	738	260	221	222
Seated Power	r	.628**	.618**	.381**	.408**	1	.637**	.658**	-.465**	-.621**	-.524**	.672**	.738**	.689**	-.531**	.751**
Throw (m)	n	740	741	740	741	741	741	741	498	331	504	504	738	260	221	222
Standing Long	r	.414**	.166**	-.043	.561**	.637**	1	.534**	-.426**	-.531**	-.532**	.511**	.561**	.572**	-.390**	.441**
Jump (cm)	n	740	741	740	741	741	741	741	498	331	504	504	738	260	221	222
Strength Deadlift	r	.495**	.498**	.329**	.409**	.658**	.534**	1	-.375**	-.603**	-.474**	.688**	.603**	.606**	-.475**	.643**
(lbs.)	n	740	741	740	741	741	741	741	498	331	504	504	738	260	221	222
Foot march Time	r	-.414**	-.276**	-.101*	-.418**	-.465**	-.426**	-.375**	1	.570**	.332**	-.405**	-.440**	.060	.220**	-.285**
(min)	n	497	498	497	498	498	498	498	498	325	498	498	495	17	221	222
Sandbag Time	r	-.561**	-.527**	-.330**	-.468**	-.621**	-.531**	-.603**	.570**	1	.538**	-.605**	-.642**	-.633**	.273	-.519**
(min)	n	330	331	330	331	331	331	331	325	331	331	331	328	23	48	49
Move Under Fire	r	-.381**	-.240**	-.081	-.484**	-.524**	-.532**	-.474**	.332**	.538**	1	-.531**	-.534**	-.522*	.462**	-.555**
Time (min)	n	503	504	503	504	504	504	504	498	331	504	504	501	23	221	222

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Cannot be computed because at least one of the variables is constant.

Table 7 (continued). Correlations among body size, OPAT events and CMTSs for all recruits who completed the study

		Height (cm)	Mass (kg)	BMI	IAR (shuttles)	SPT (m)	SLJ (cm)	SDL (lbs.)	Foot march (min)	Sandbag Carry (min)	Move Under Fire (min)	Casualty Evac (lbs.)	Casualty Drag (m/s)	FAASV (rds/min)	Load Main Gun (sec)	Stow Ammo (rds/min)
Casualty Evac	r	.484**	.558**	.416**	.413**	.672**	.511**	.688**	-.405**	-.605**	-.531**	1	.675**	.552**	-.543**	.723**
Weight (lbs.)	n	503	504	503	504	504	504	504	498	331	504	504	501	23	221	222
Casualty Drag	r	.571**	.572**	.360**	.412**	.738**	.561**	.603**	-.440**	-.642**	-.534**	.675**	1	.718**	-.556**	.725**
Speed (m/s)	n	737	738	737	738	738	738	738	495	328	501	501	738	260	219	220
FAASV Load Rate	r	.576**	.567**	.324**	.455**	.689**	.572**	.606**	.060	-.633**	-.522*	.552**	.718**	1	C	C
(rounds/min)	n	260	260	260	260	260	260	260	17	23	23	23	260	260	0	0
Load Main Gun	r	-.380**	-.414**	-.328**	-.285**	-.531**	-.390**	-.475**	.220**	.273	.462**	-.543**	-.556**	C	1	-.698**
Time (sec)	n	221	221	221	221	221	221	221	221	48	221	221	219	0	221	221
Stow Ammo Rate	r	.635**	.624**	.453**	.362**	.751**	.441**	.643**	-.285**	-.519**	-.555**	.723**	.725**	C	-.698**	1
(rounds/min)	n	222	222	222	222	222	222	222	222	49	222	222	220	0	221	222

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Cannot be computed because at least one of the variables is constant.

PREDICTION VALIDATION AND ACCURACY

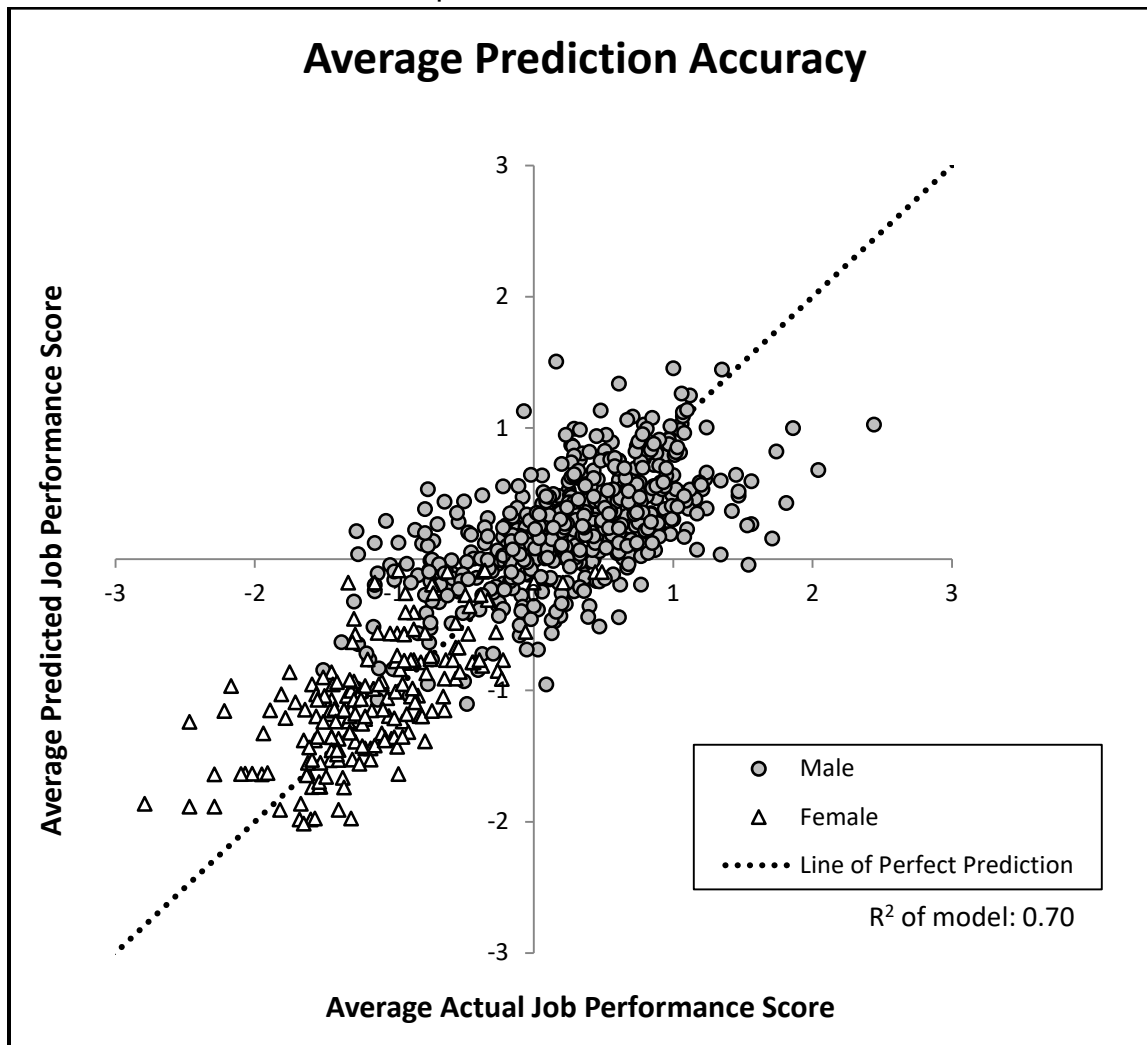
Regression analyses resulted in coefficients of determination (R^2 ; Table 8) for the ability of the OPAT to predict job performance scores of 0.77 for the Common Task MOSs, 0.62 for the 13B, and 0.72 for the 19K ($p < 0.01$ for all). When the average job performance score was used to include all seven MOSs in the same regression analysis, the ability of the OPAT to predict performance of all seven MOSs resulted in a validity coefficient (R^2) of 0.70 ($p < 0.01$, Figure 6). When the regression analyses were run separately for men and women, the coefficients of determination were greatly reduced from the full sample analyses (Table 8), but more so in men (range of $R^2 = 0.33$ -0.48) than in women (range of $R^2 = 0.42$ -0.60). Based on a sex moderated regression analysis for the full sample, there was no significant difference in the ability of the OPAT to predict performance of men and women ($F_{4,790} = 2.08$, $p = 0.08$).

Table 8. Coefficients of Determination [R^2] of the OPAT events regressed on job performance scores for the three MOS groups individually and all for groups combined.

	Combined R^2*	Male R^2*	Female R^2*
Common MOSs	0.77	0.48	0.54
13B	0.62	0.33	0.42
19K	0.72	0.38	0.60
All MOSs Combined	0.70	0.37	0.47

* $p < 0.01$ for all

Figure 6. Average predictive capability of the OPAT to predict performance of CMTSs for all MOSs combined. Data points are coded for sex.



CUT-SCORES ACCURACY

Table 9 shows the percentage of recruits that were correctly classified. This is defined as those Soldiers who passed both the TRADOC Black/Heavy Physical Demand Standard on the OPAT and the MAPS on all of the CMTSs for their MOS or failed both the OPAT and the CMTSs. Correct identification was 76% for all MOS groups combined, 78% for the Common Task MOSs, 77% for the 13B, and 73% for the 19K. Classification accuracy was generally higher in women than in men, in part due to the higher false fail rate in men (not achieving Black level OPAT score, but performing the CMTSs to MAPS). The false fail rate for men ranged from 15-31% for the three MOS groupings. The false fail rates for women were much lower and ranged from 1-7%.

The classification data from the current study were examined to identify any adjustments that might need to be made based on contingency tables for each OPAT event (Tables 10-13). The full contingency tables are included in Appendices A2-A9 for PDS Soldiers and Appendices B6-B9 for OPAT recruits. Figures 7-10 depict the effects of cut-score placement on the accuracy of the prediction, as well as the false positive and false negative predictions for the black category MOSs. The three lines in each chart add up to 100%. The gray and gold category cut-scores are shown on the graph, but none of the data herein pertain to those, as all combat arms MOSs are in the Black category.

Table 9. Accuracy of cut-scores by MOS group and sex.

	Common Task MOSs			13B			19K		
	All CT	M	W	All 13B	M	W	All 19K	M	W
<i>n</i>	325	251	74	260	184	76	219	173	46
Correctly Classified	78%	75%	89%	77%	70%	95%	73%	68%	91%
True Pass	58%	72%	8%	41%	57%	22%	53%	66%	22%
True Fail	20%	3%	81%	36%	13%	73%	20%	1%	69%
False Pass	5%	6%	4%	12%	15%	4%	1%	1%	2%
False Fail	16%	19%	7%	11%	15%	1%	26%	31%	7%

M: Men, W: Women;

Correctly Classified: True Pass + True Fail; **True Pass:** Pass OPAT at Black Level & Complete all CMTSs to Standard, **True Fail:** Not Achieve OPAT Black Level & Not Complete all CMTSs to Standard, **False Pass:** Pass OPAT at Black Level & Not Complete all CMTSs to Standard, **False Fail:** Not Achieve OPAT Black Level & Complete all CMTSs to Standard

Table 10. Contingency table for standing long jump from OPAT study data.

Cut-Score <i>cm</i>	11B, 11C, 12B, 13F, 19D			13B			19K		
	C	FP	FF	C	FP	FF	C	FP	FF
100	74%	26%	0%	52%	48%	0%	76%	24%	0%
120	76%	24%	0%	53%	47%	0%	77%	24%	0%
125	77%	23%	0%	53%	47%	0%	79%	21%	0%
140	78%	20%	2%	60%	38%	2%	81%	18%	1%
150	81%	15%	3%	65%	33%	3%	84%	12%	4%
160	80%	14%	6%	69%	28%	3%	81%	11%	8%
175	79%	8%	13%	74%	18%	8%	74%	7%	19%
180	78%	6%	15%	76%	15%	10%	71%	5%	24%
200	65%	3%	32%	71%	8%	21%	54%	4%	42%

Colored bars indicate the level of the cut-score as established by TRADOC (black, gray, gold).

CORRECT (C): Achieve Passing OPAT cut-score /Met Standards for CMTSs or Not Achieve Passing OPAT cut-score /Not Meet Standards for CMTSs

FALSE PASS (FP): Achieve Passing OPAT cut-score /Not Meet Standards for CMTSs

FALSE FAIL (FF): Not Achieve Passing OPAT cut-score /Met Standards for CMTSs

Table 11. Contingency table for seated power throw from OPAT study data.

Cut-Score <i>cm</i>	11B, 11C, 12B, 13F, 19D			13B			19K		
	C	FP	FF	C	FP	FF	C	FP	FF
300	74%	26%	0%	52%	48%	0%	76%	24%	0%
325	74%	26%	0%	55%	45%	0%	76%	24%	0%
350	77%	23%	0%	57%	43%	0%	79%	21%	0%
375	81%	19%	0%	65%	35%	0%	83%	17%	0%
400	85%	15%	0%	70%	30%	0%	87%	13%	0%
425	89%	10%	1%	75%	25%	0%	89%	10%	1%
450	90%	9%	1%	79%	21%	0%	91%	8%	1%
475	90%	6%	4%	80%	18%	1%	93%	5%	1%
500	88%	5%	7%	82%	15%	3%	93%	4%	3%

Colored bars indicate the level of the cut-score as established by TRADOC (black, gray, gold).

CORRECT (C): Achieve Passing OPAT cut-score/Met Standards for CMTSs or Not Achieve Passing OPAT cut-score /Not Meet Standards for CMTSs

FALSE PASS (FP): Achieve Passing OPAT cut-score /Not Meet Standards for CMTSs

FALSE FAIL (FF): Not Achieve Passing OPAT cut-score /Met Standards for CMTSs

Table 12. Contingency table for strength deadlift from OPAT study data.

Cut-Score <i>lbs.</i>	11B, 11C, 12B, 13F, 19D			13B			19K		
	C	FP	FF	C	FP	FF	C	FP	FF
60	74%	26%	0%	52%	48%	0%	76%	24%	0%
100	74%	26%	0%	52%	48%	0%	76%	24%	0%
120	Not Tested			Not Tested			Not Tested		
140	76%	24%	0%	55%	45%	0%	78%	21%	0%
160	Not Tested			Not Tested			Not Tested		
180	83%	16%	1%	68%	31%	0%	83%	19%	1%
220	88%	5%	7%	80%	19%	2%	90%	4%	6%

Colored bars indicate the level of the cut-score as established by TRADOC (black, gray, gold).

CORRECT (C): Achieve Passing OPAT cut-score /Met Standards for CMTSs or Not Achieve Passing OPAT cut-score /Not Meet Standards for CMTSs

FALSE PASS (FP): Achieve Passing OPAT cut-score /Not Meet Standards for CMTSs

FALSE FAIL (FF): Not Achieve Passing OPAT cut-score /Met Standards for CMTSs

Table 13. Contingency table for interval aerobic run from OPAT study data.

Cut-Score <i>Total Shuttles</i> (level, shuttle)	11B, 11C, 12B, 13F, 19D			13B			19K		
	C	FP	FF	C	FP	FF	C	FP	FF
30 (L4, S7)	81%	18%	1%	62%	37%	1%	82%	16%	3%
32 (L4, S9)	81%	17%	2%	62%	36%	2%	82%	15%	4%
34 (L5, S2)	82%	15%	3%	63%	33%	3%	79%	12%	9%
36 (L5, S4)	80%	14%	5%	64%	32%	4%	78%	11%	11%
38 (L5, S6)	81%	13%	3%	67%	29%	4%	80%	8%	12%
40 (L5, S8)	79%	13%	8%	68%	27%	6%	79%	8%	13%
41 (L5, S9)	80%	12%	8%	68%	25%	7%	78%	8%	14%
42 (L6, S1)	80%	12%	8%	69%	24%	7%	76%	8%	16%
43 (L6, S2)	79%	10%	12%	70%	22%	9%	74%	6%	21%
44 (L6, S3)	79%	9%	12%	70%	20%	10%	72%	5%	22%
46 (L6, S5)	76%	8%	16%	69%	19%	12%	70%	4%	26%
48 (L6, S7)	74%	8%	18%	68%	17%	14%	66%	4%	30%
50 (L6, S9)	73%	7%	20%	69%	16%	15%	63%	4%	32%
51 (L6, S10)	72%	6%	21%	68%	15%	17%	62%	4%	35%

Colored bars indicate the level of the cut-score as established by TRADOC (black, gray, gold).

CORRECT (C): Achieve Passing OPAT cut-score/Met Standards for CMTSs or Not Achieve Passing OPAT cut-score/Not Meet Standards for HPDTs

FALSE PASS (FP): Achieve Passing OPAT cut-score/Not Meet Standards for CMTSs

FALSE FAIL (FF): Not Achieve Passing OPAT cut-score/Met Standards for CMTSs

ADVERSE IMPACT OF OPAT ON WOMEN

The adverse impact on women for the CMTSs of the Common Task, 13B, and 19K MOSs is shown in Table 14. Adverse impact on the OPAT selection compares the percentage of men versus the percentage of women passing the OPAT at the Black category cut-score. The 4/5th rule states that a protected class (women) should not fail at a rate that is greater than 4/5th or 80% of the non-protected class (men).¹⁸ Based on the 4/5th rule, there is adverse impact towards women. For all MOSs combined, women passed the OPAT black level at 11.9% of the rate passed by men. This, however, was not unexpected as women passed the CMTSs at 11.2% of the rate passed by men. Examination of the individual MOSs reveals a similar pattern for the three groupings (Common Task MOSs, 13B and 19K). These data show that the OPAT is a true reflection of the gender differences in actual task performance.

Table 14. Adverse Impact to OPAT Study women on the OPAT and CMTS.

	OPAT		CMTSs	
	<u>Female Pass Rate</u> Male Pass Rate	Adverse Impact Rate	<u>Female Pass Rate</u> Male Pass Rate	Adverse Impact Rate
Common task MOSs	<u>12.1%</u> 77.7%	15.5%	<u>14.9%</u> 91.2%	16.3%
13B	<u>6.6%</u> 71.7%	9.2%	<u>3.9%</u> 71.2%	5.5%
19K	<u>6.5 %</u> 77.7%	11.2%	<u>10.9%</u> 93.6%	11.6%
Combined	<u>8.7%</u> 72.9%	11.9%	<u>9.7%</u> 85.9%	11.2%

EFFECT OF OPAT SCORE ON ATTRITION

Of the total population, 6.5% of men and 7.3% of women were no longer with their class at 10 weeks into the IET cycle. The results of a two-way ANOVA (sex by graduate/non-graduate) are listed in Table 15. For the combined sample, there were main effects for IAR, SLJ and SDL. In each variable, recruits who graduated on time achieved significantly higher scores than those who were no longer training with their class. There was a significant interaction effect for SDL. A post-hoc Tukey test revealed that women who graduated with their class at 10 weeks had significantly greater deadlift strength than those who did not graduate on time. The differences for the individual events of the OPAT ranged from 1-13% in men and from 7-34% in women. In both sexes the largest differences were in the IAR, again demonstrating the importance of aerobic fitness to success in IET.²⁴

Table 15. Comparison of OPAT scores by sex for graduates of IET versus those who did not graduate on time with their class (either due to recycling or attrition).

OPAT Event	Male Graduate	Male Non-Graduate	Female Graduate	Female Non-Graduate	Combined Graduate	Combined Non-Graduate
	n=886	n=62	n=216	n=17	n=1102	n=79
Interval Aerobic Run (shuttles)	56.1 ± 18.0	48.6 ± 17.6	34.0 ± 14.2	22.6 ± 10.6	51.8 ± 19.4	43.0 ± 19.5*
Seated Power Throw (cm)	593.9 ± 81.2	583.6 ± 81.0	389.6 ± 51.3	359.0 ± 44.8	553.8 ± 111.3	535.3 ± 111.3
Standing Long Jump (cm)	199.0 ± 29.9	189.5 ± 27.8	149.1 ± 23.4	138.2 ± 21.9	189.2 ± 34.9	178.5 ± 34.0*
Strength Deadlift (kg) ¹	96.9 ± 0.4	95.9 ± 1.4	74.3 ± 0.7	64.7 ± 2.6 ⁺	92.5 ± 14.0	89.2 ± 17.8*

¹Deadlift capped at 100 kg

⁺Significant interaction effect, Tukey revealed difference between Female GR+ and Female GR-, only.

*Significant main effect for Graduate (p<0.05).

DISCUSSION

The goal of the OPAT is to identify recruits with the potential to be successful in physically demanding Army occupations prior to shipping them to train for the MOS. The OPAT correctly identified ~76% of recruits. The predictive validation conducted in recruits yielded similar results to the concurrent validation study previously conducted in fully trained Soldiers.^{1, 2} Table 16 shows that the level of predictive capability tended to be lower for recruits than for trained PDS Soldiers. There was a longer time period between performing the OPAT and the CMTSs for the recruits (roughly 12-15 weeks) than for the trained Soldiers (within 2 weeks); thus, the relationship would be expected to be weaker.²⁵ The results of this study demonstrate that the OPAT measured at the beginning of training is predictive of recruit CMTS performance at the end of training, therefore the OPAT is suitable for pre-enlistment testing and assignment of recruits to appropriate MOSs.

Table 16. Predictive capability of OPAT in fully-trained PDS Soldiers (concurrent validity) and OPAT Study new recruits (predictive validity).

	Concurrent Validation Trained Soldiers R² N=838	Predictive Validation New Recruits R² N=804
Common MOSs	0.79	0.77
13B	0.81	0.62
19K	0.80	0.72
All MOSs	0.80	0.70

All combat arms MOSs are assigned to the Black physical demand category. Table 17 lists the accuracy of the classification of participants into the Black category for the PDS (trained Soldiers) and for the OPAT study (recruits). The accuracy of the assignment dropped about 10% from the PDS to the OPAT sample. The high false fail rate in men, particularly for the 19K MOS (see Table 9), may be of concern as a large number of recruits who were capable of performing the CMTSs at the end of training would not have been accepted for training. The 31% false fail rate for 19K men suggests that the OPAT cut-scores are too high or that the MAPS are too low. The IAR was the event that was most frequently failed by 19K men, so it is possible that this standard is too high. Lowering the IAR standard may not be advisable; however, since a higher level of aerobic fitness has frequently been shown to be protective for both injury and attrition/on-time graduation in IET.^{24, 26} In the OPAT sample, recruits who completed the CMTSs post testing had a significantly higher IAR score than those who did not, again, demonstrating the need for aerobic fitness in IET.

Table 17. Classification of participants into the correct categories by study and MOS grouping.

		Physical Demands Study (n=877)	OPAT Study (n=804)
MOS	Classification	%	%
Common Task MOSs	Correctly Classified (True Pass/True Fail)	90 (79/11)	78 (58, 20)
	False Pass	9	5
	False Fail	2	16
		n=514	n=326
13B	Correctly Classified (True Pass/True Fail)	86 (71/15)	77 (41, 36)
	False Pass	12	12
	False Fail	2	11
		n=180	n=260
19K	Correctly Classified (True Pass/True Fail)	85 (74/11)	73 (53, 20)
	False Pass	8	1
	False Fail	7	26
		n=183	n=219

Setting the cut-score that works for multiple MOSs is a policy decision that must be made by senior Army leaders based on the Army's needs and the current recruiting climate. If the cut-scores are increased the number of false passes decreases, while the number of false failures increases. Army leaders must determine if they will allow more false passes, thus maximizing opportunities for Soldiers, or reduce the number of false passes, thus minimizing attrition and possibly injury. While reducing the number of false passes should result in lower training attrition and injury rates, it will also result in a reduction in the available training population because more people will fail the test. Recruiting and training a single enlisted Soldier costs upwards of \$50,000 from first contact until they reach their first duty station. The Army recruits approximately 140,000 people each year. 11-12% of IET recruits do not graduate. Data from this study show that better performance on the OPAT was related to reduced attrition at 10 weeks into IET. Even a small reduction in attrition (i.e., 0.5%) would result in a large return on the Army's training investment and an increase in military readiness (Personal communication, Mr. Michael McGurk, TRADOC CIMT, Ft Eustis, VA, Sept 2017).²⁷

Figures 7-10 illustrate the effects of the location of the cut-score on categorizing recruits. The SLJ (Figure 7) and SPT (Figure 8) reveal that the cut-score is maximizing correct categorization (true pass/fail), but is somewhat liberal in allowing more individuals with false passes to start training. It does minimize the number of false failures, which is important so people who could be successful are not denied the chance to train. Based on Figure 9, it could be argued the SDL cut-score should be

increased to improve the accuracy of the prediction; however, it results in minimal false failures and only moderate false passes. Increasing the score to 200 lbs. would increase the percentage of recruits correctly identified, while reducing the number of false passes. False passes give the recruit the opportunity to train for the MOS of their choice; however, if the recruit is not physically capable, it may result in attrition or injury. Figure 10 for the IAR reveals a nearly perfect cut-score for the Black Physical Demand category MOSs. A cut-score at 43 shuttles maximizes the correct identification of successful recruits, while balancing the false passes and false failures at approximately 12% each.

Figure 7. Standing long jump contingency table data graphically displayed for OPAT recruits (n=804). The vertical lines mark the current cut-scores for each of the MOS categories, but the data are all for black category combat arms MOSs.

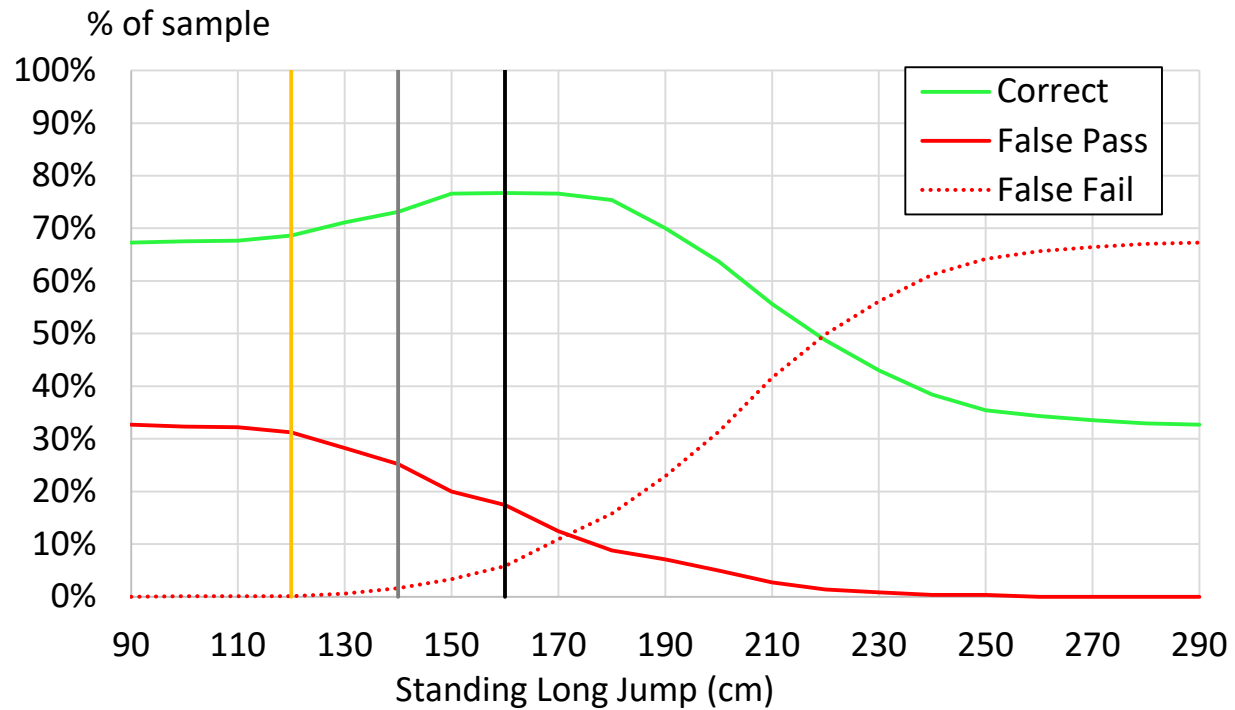


Figure 8. Seated power throw contingency table graphically displayed for OPAT recruits (n=804). The vertical lines mark the current cut-scores for each of the MOS categories, but the data are all for black category combat arms MOSs.

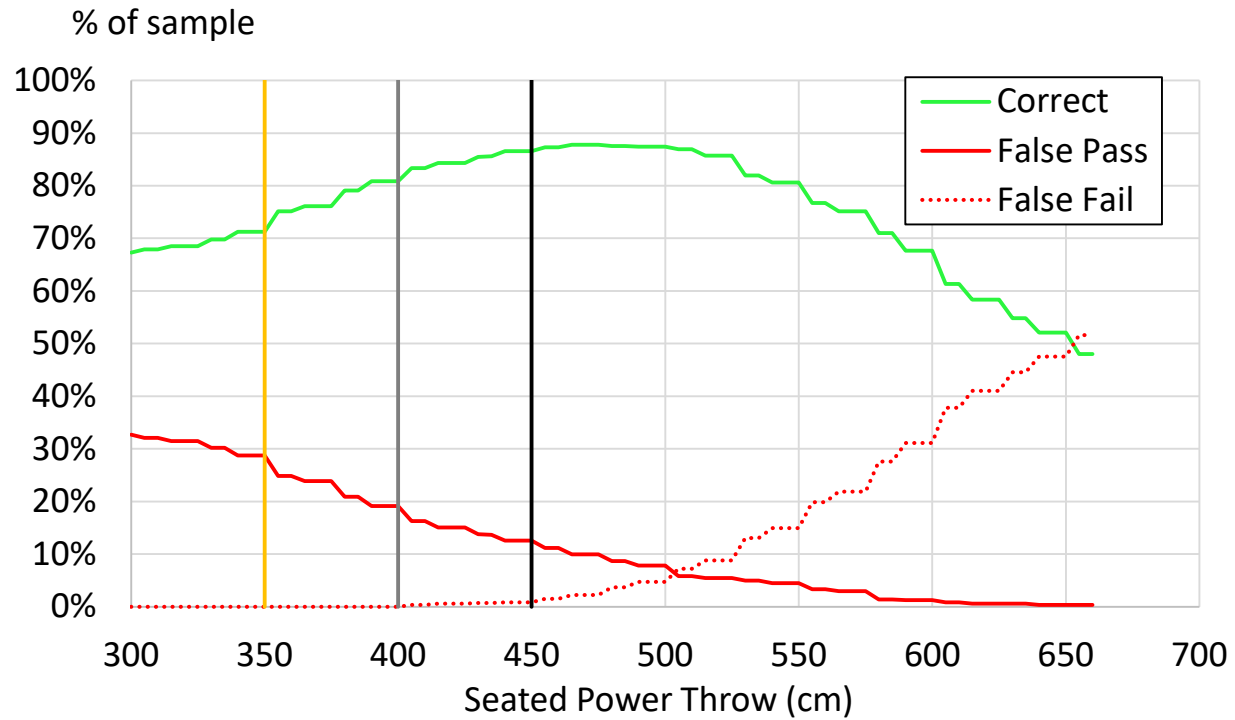


Figure 9. Strength deadlift contingency table graphically displayed for OPAT recruits (n=804). The vertical lines mark the current cut-scores for each of the MOS categories, but the data are all for black category combat arms MOSs.

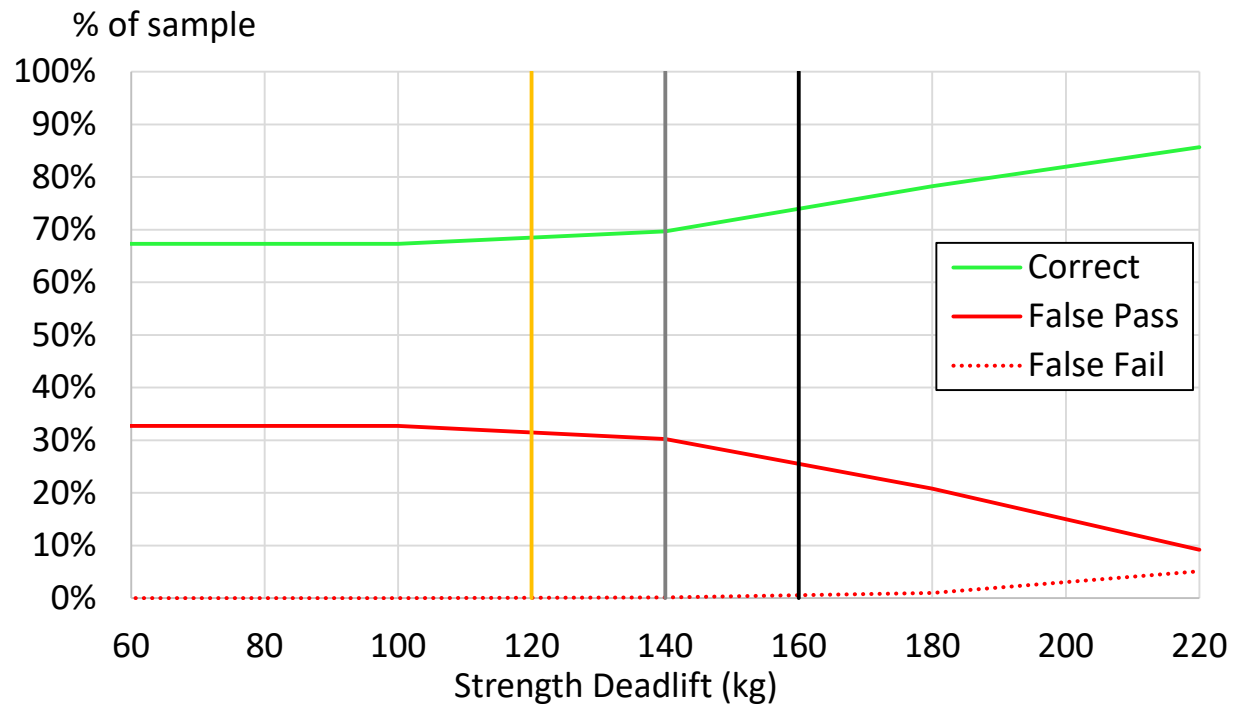
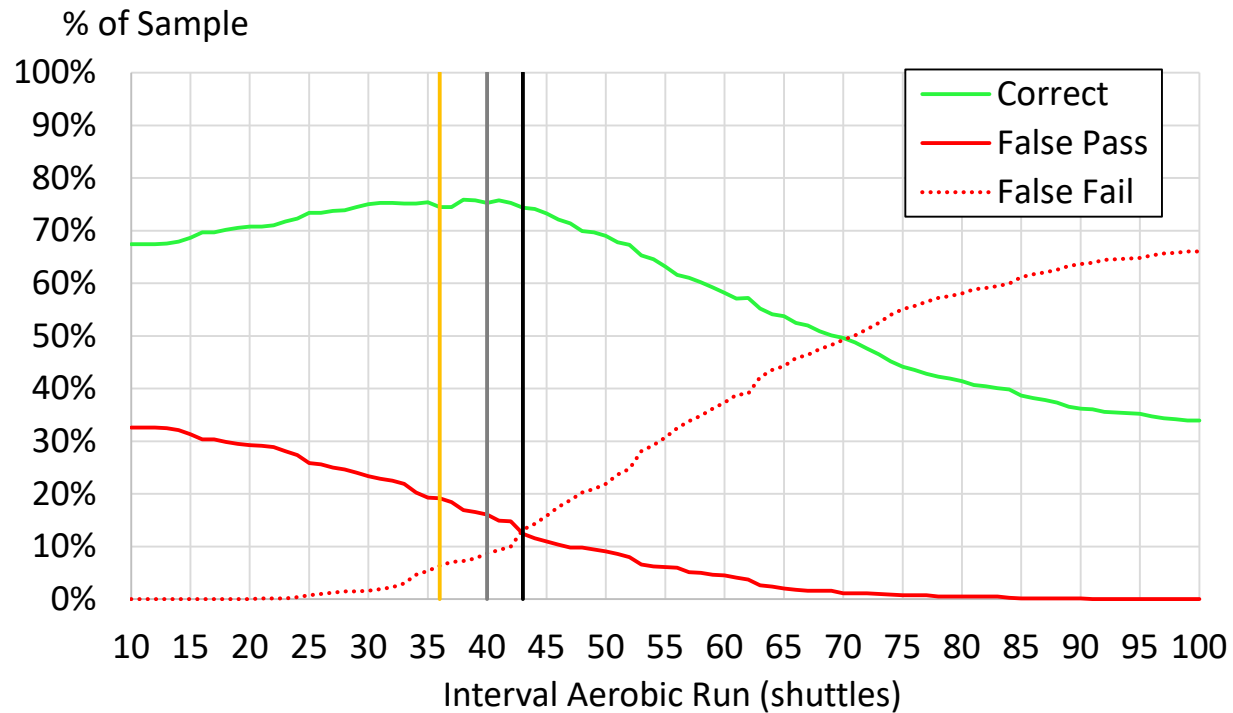


Figure 10. Interval aerobic run contingency table graphically displayed for OPAT recruits (n=804). The vertical lines mark the current cut-scores for each of the MOS categories, but the data are all for black category combat MOS.



One dilemma faced by TRADOC when setting OPAT cut-scores for new recruits was that the cut-scores were based on data from fully trained Soldiers. At the time the cut-scores were set, the difference in performance on the OPAT between trained Soldiers and new recruits was not known. A two-way ANOVA (training by sex) was used to analyze the differences in OPAT performance between PDS Soldiers (510 men and 186 women) and the OPAT study recruits who completed both OPAT and CMTS testing (608 men and 133 women). These results are listed in Table 18. The SPT scores for the PDS group were reduced by 2.5% to account for differences in methods used (chair versus seated on floor; see Methods section). Trained Soldiers scored slightly higher ($p < 0.01$) than recruits on all OPAT events, except for SDL where trained Soldiers scored less than recruits. There was also a significant study by sex interaction for SDL, resulting from trained PDS women lifting 6% less than OPAT women recruits. These seemingly conflicting results for the SDL may have been due to the differences in the methods used (dumbbells versus hexagon barbell and larger increases in weight between lifts; see Methods section). The IAR event had the largest difference between trained Soldiers and recruits. This is likely due to the heavy focus of Army physical training on running. The small differences observed between trained Soldiers and recruits in the remaining three test events highlights the lack of emphasis on muscular strength and power incorporated into Army physical training. These relatively small differences due to training status indicate that the OPAT is likely to work well for the recruit population and that developing the cut-scores based on fully trained Soldiers was reasonable, with the possible exception of the IAR. These findings also indicate that recruits need to arrive to IET ready for the physical challenges they will face, rather than expecting IET training to result in significant gains in muscular strength and power. Utilizing the OPAT at the recruit point of entry will benefit the Army and the recruit, by placing the recruit in an MOS that is compatible with their physical capabilities. These data also point to the need to develop Army physical training programs (in IET and for active duty Soldiers) to improve muscular strength and power in all Soldiers.

Table 18. Comparison of OPAT scores for fully trained PDS Soldiers and OPAT study new recruits (estimated mean \pm standard error).

Sex	Study (n)	Standing Long Jump (cm)	Seated Power Throw (cm)	Strength Deadlift (lbs.)	Interval Aerobic Run (shuttles)
Males	OPAT recruit (n=608)	200.4 \pm 1.1	597.4 \pm 3.1	214.5 \pm 0.9	57.8 \pm 0.7
	PDS Soldier (n=510)	206.6 \pm 1.2	604.9 \pm 3.4	215.1 \pm 1.0	63.8 \pm 0.7
Females	OPAT recruit (n=133)	151.6 \pm 2.3	388.3 \pm 6.6	163.2 \pm 1.9 ^a	35.8 \pm 1.4
	PDS Soldier (n=186)	160.6 \pm 2.0	401.0 \pm 5.6	153.7 \pm 1.6	43.8 \pm 1.2
All	OPAT recruit (n=741)	176.0 \pm 1.3 ^b	492.8 \pm 3.6 ^b	188.9 \pm 1.1 ^b	53.8 \pm 0.7 ^b
	PDS Soldier (n=696)	183.6 \pm 1.1	502.9 \pm 3.2	184.4 \pm 0.9	46.8 \pm 0.8

^a Significantly different from PDS women ($p < 0.05$) based on ANOVA interaction effect.

^b Significantly different from PDS all ($p < 0.05$).

TRADOC officials report that recruits are not expected to be fully physically trained until they have completed approximately six months of training at their first unit of assignment. The CMTS scores of the PDS and OPAT study were compared to determine if the fully trained PDS Soldiers were performing at a higher level than the OPAT recruits (see Table 19). It should be recalled that there were some differences in the methodologies used during the two studies. For example, during the tactical foot march the PDS Soldiers wore body armour, whereas the OPAT recruits did not, resulting in a 33-lb difference in load. The load difference for the foot march is reflected in the OPAT recruits completing the four-mile distance roughly 13 minutes (16%) faster than the PDS Soldiers. The PDS Soldiers performed significantly better on the remaining seven tasks. Percentage differences ranged from 2% (move under fire) to 34% (casualty drag). When sex was considered, the PDS men outperformed the OPAT men on all CMTSs except for the foot march. The superiority of the trained PDS men continued even when considered across MOSs. The OPAT women were not different from the PDS women on the stow ammo (-2% difference, $p = 0.84$) or the sandbag carry (13% difference, $p = 0.09$) tasks. No difference on the stow ammo task is not surprising. None of the women from either study were assigned to an Armor MOS, so both groups received the same amount of training on the tasks. While this line of reasoning seems logical, no PDS women were assigned to the 13B MOS; yet, they outperformed OPAT women on the FAASV task.

Table 19. Comparison of performance of CMTSs in experienced PDS Soldiers with OPAT recruits.

Tasks	Combined		Men		Women	
	PDS	OPAT	PDS	OPAT	PDS	OPAT
Foot march (min)	79.88 ± 11.52 n=783	67.02 ± 7.01** n=514	75.68 ± 7.64 n=553	65.71 ± 6.06** n=434	89.98 ± 12.93 n=230	74.10 ± 7.60** n=80
Sandbag Carry (min)	2.09 ± 0.85 n=624	2.38 ± 0.90** n=353	1.72 ± 0.30 n=437	2.06 ± 0.43* n=266	2.95 ± 1.06 n=187	3.34 ± 1.22 n=87
Move Under Fire (min)	2.34 ± 0.24 n=623	2.39 ± 0.27** n=543	2.23 ± 0.15 n=435	2.32 ± 0.21** n=458	2.58 ± 0.24 n=188	2.75 ± 0.27** n=85
Casualty Evacuation (lbs.)	182 ± 41 n=838	177 ± 43* n=545	200 ± 23 n=608	189 ± 33** n=459	133 ± 38 n=230	113 ± 32* n=86
Casualty Drag (m·sec ⁻¹)	0.95 ± 0.44 n=838	0.62 ± 0.36** n=780	1.15 ± 0.30 n=608	0.73 ± 0.31** n=643	0.42 ± 0.29 n=230	0.14 ± 0.16** n=137
FAASV (rounds·min ⁻¹)	3.10 ± 1.46 n=181	2.48 ± 1.51** n=269	3.80 ± 1.20 n=122	3.07 ± 1.35** n=191	1.66 ± 0.69 n=59	1.05 ± 0.72** n=78
Load Main Gun (sec)	20.41 ± 5.91 n=184	22.36 ± 5.00** n=245	16.65 ± 2.69 n=94	21.30 ± 4.33** n=193	24.34 ± 5.81 n=90	26.28 ± 5.40** n=52
Stow Ammo (min)	5.52 ± 2.66 n=184	6.29 ± 2.28** n=245	7.62 ± 1.30 n=94	7.12 ± 1.60* n=192	3.33 ± 1.83 n=90	3.27 ± 1.76 n=53

*Significantly different from PDS, p< 0.05.

**Significantly different from PDS p< 0.01

Adverse impact occurs when a protected group (women, minorities, ethnic group) is not treated equally as the result of an employment practice¹⁸. For example, if women pass the OPAT at a rate that is significantly less than (four fifths or 80%) the passing rate that of men. Due to the known physiological differences between men and women, physical employment standards testing usually results in adverse impact. The percentage of women and men that perform the CMTSs to standard must then be examined. Administration of the OPAT test had an adverse impact on the passing rate of women in both the PDS and the OPAT study as detailed in Table 20. The passing rates for the OPAT test and the CMTS tests were similar for the OPAT study recruits. Because the passing rate on the OPAT test reflects the passing rate on the job tasks adverse impact is both expected and acceptable. This was not the case for the PDS Soldiers. The women in the PDS passed the OPAT at a rate that was 12.3% than of men, however, the women scored significantly better on the CMTSs in comparison to the men (female:male ratio= 49%) than the task performance comparison in the OPAT study (female:male ratio= 11%). This would be interpreted as the OPAT having an unacceptable adverse impact on women. These results are likely due the superior performance of PDS women on the strength demanding CMTSs such as the casualty drag and casualty evacuation. The adverse impact of the individual OPAT and CMTSs are listed in Table B10. The OPAT was not intended to test fully trained Soldiers, so these results for the PDS personnel should be interpreted with caution. In addition, there were no PDS women trained for a combat MOS. The close match in OPAT Study personnel between OPAT and CMTS adverse impact ratio is a good indicator that the test is appropriate for the recruit population.

Table 20. Comparison of adverse impact of the OPAT and CMTSs testing on PDS women versus OPAT women.

	Physical Demands Study		OPAT Study	
	OPAT Adverse Impact Rate	CMTS Adverse Impact Rate	OPAT Adverse Impact Rate	CMTS Adverse Impact Rate
Common Task MOSS	10.4%	55.7%	15.5%	16.3%
13B	9.5%	25.8%	9.2%	5.5%
19K	16.5%	52.8%	11.2%	11.6%
Combined	12.3%	49.2%	11.9%	11.2%

LIMITATIONS

The data contained in this report were collected for the purpose of developing a physical employment standard screening test for combat arms Soldiers. The test has since been implemented for all Soldiers. Had this been the tasking to USARIEM, it would have been appropriate to develop a set of high physically demanding tasks/CMTS that could apply to all Soldiers based on the Warrior Task and Battle Drills/Common Soldiering Tasks (WTBD/CST). These WTBD/CSTs are considered essential for all Soldiers, regardless of their MOS. These tasks may have had different MAPS for different MOSs.

TRADOC requested several of the OPAT testing procedures be modified for administrative and safety reasons. Because this request occurred between the conduct of the PDS and the current study these changes were incorporated into the current study. The SPT was performed while sitting in a chair during the PDS versus while sitting on the floor against a wall with a yoga block placed at the base of the spine in the current study. The TRADOC's concern was the standardization of the chair height, and having one additional piece of equipment required to conduct the test. In both cases, the shoulders had to remain in contact with the supporting structure (chair or wall). A ballistic engineering estimate indicated that the expected difference in the throwing distance would be approximately 2.5% of the score. This results in a greater decrement to those with higher scores (i.e., the average PDS male who scored 635 cm would obtain a score of 603 cm with the current testing method). The current black category standard is 450 cm, so this will have the greatest effect on those individuals who are very close to the required score (i.e., the 75th percentile PDS females). A future study is planned to ensure that this is accurate; however, since the testing being conducted is the same as the methods used in the current study, cut-scores based on the current data are supportable.

The equipment and loads used for the strength deadlift were also changed from the PDS to the OPAT Study. The PDS utilized dumbbells in weights from 60-220 lbs. in 20-pound increments. The OPAT study utilized a hexagon barbell and weights from 60-220 lbs. in 40-lb increments. This change reduced the number of lifts as well as the accuracy of the measurement. The hexagon barbell is thought to be a safer deadlift method than heavy barbell or dumbbell lifts, because it is easier to maintain an upright spine and there is a lower likelihood of dropping a weight onto a foot.²⁸⁻³⁰ In addition, the dumbbells tend to bump up against the outer thighs while lifting potentially causing contusions, whereas the hexagon barbell does not change its position in relation to the lifter during the act of lifting. The change in load increments to 40-lbs reduced the fatigue from multiple submaximal loads and decreased the time to administer the test. The cut-scores identified by TRADOC for the strength deadlift were 120-, 140- and 160 lbs. for the three OPAT categories (see Table 1). These cut-scores were not established until after the OPAT Study was underway. Due to the use of 40-lb increments, the strength deadlift procedure utilized in this study did not test the Soldiers' ability to lift 120- or 160 lb. Therefore, recruits who lifted 140 lbs., but failed to lift 180 lbs. would be rated as failing the OPAT for the black level. It is likely some of these recruits may have been able to lift 160 lbs. and would be false failures as a result of the testing methods. A future study is planned to compare deadlift strength using the two

different pieces of equipment as well as different increases between loads. The weight selection would result in false failures in ~ 13% of women based on normative data from the PDS, but have little effect on men who tended to lift more than 160-lbs.¹

The Initial Military Training Centers, particularly the Infantry School, were concerned that the tactical foot march load was too heavy for trainees and would result in injuries. It was decided that the trainees would not wear body armor, but would maintain the rest of the uniform as specified. This reduced the load by 27-41 lbs. depending on the size of the body armor for a total load of approximately 67 lb. Some of the testing procedures for both the OPAT events (deadlift) and for the CMTSS (casualty evacuation, foot march,) changed from the PDS to the OPAT study. Because a second predictive validation study was conducted, this did not present a validity problem for implementation, but it makes the comparison of the data between the two studies more difficult.

When the PDS was initiated, USARIEM was instructed to use the best measures possible, with no limitations. Despite this freedom of choice, USARIEM selected tests we judged would be acceptable for mass implementation, probably in a Military Entrance Processing Station. We did not know at that time that the tests would be conducted by recruiters in over 2000 recruiting stations across the country. The number of testing locations mandated the testing footprint, the amount of equipment as well as the cost of the equipment be kept to an absolute minimum. Had we known this from the start, we may have selected our predictor tests differently.

It would have been a more conservative implementation approach to test new recruits on the OPAT, without enforcing a specific standard for a period of time to more accurately set the cut-scores and to assess the relationship between the OPAT, on-time graduation, HPDT performance, attrition from the Army, musculoskeletal injury and migration to other MOSs for all the MOSs, not just combat arms. The OPAT was implemented and MAPS made mandatory for all MOSs immediately. This left no time to validate the test on non-combat MOSs, nor to ensure the accuracy of the cut-scores. The scores may need to be adjusted as the data are collected over time.

FOLLOW-UP

The recruits in the current study will be tracked through the first two years of their enlistment for injuries, attrition, and changing MOSs. These data have not yet been prepared for publication. They will be used to recommend adjustments to the cut-scores as needed. A follow-up study is also planned to determine what effect the methodological changes in the OPAT events between the PDS and the current study (e.g., use of hexagon barbell for the SDL, conducting the SPT from the floor) may have.

CONCLUSIONS

- The OPAT was a valid tool to identify new recruits at the point of entry to training who were capable of performing the CMTSs to the minimum standard near the end of training.
- The Black standard accurately categorized ~76% of Soldiers for the seven combat arms MOSs.
- The OPAT predicted recruit performance on the CMTSs with acceptable accuracy ($R^2=0.70$) for all seven combat arms MOSs combined.
- The OPAT appears to be predictive of attrition from IET.
- The OPAT Black standard has adverse impact on women recruits (~12%); however, this is anticipated and reasonable because their CMTS pass rate is ~11% that of men recruits.

RECOMMENDATIONS

- Following the January 2017 implementation of OPAT for all people entering the Army, Soldiers should be tracked for CMTS performance, injury, recycling and attrition to fine tune the cut-scores.
- The CMTSs' standards should be re-evaluated on a regular basis (~every two years) to ensure accuracy.
- The CMTS testing procedures should be standardized.
- The Grey and Gold category cut-scores should be validated in non-combat MOSs and in all targeted populations (officers, cadets, incumbents).
- The effectiveness of the OPAT in selecting Soldiers wishing to reclassify must be evaluated.
- Reducing the cut-score for IAR would reduce the false failures, particularly the 19K male false fail rate which would be reduced by (31%).

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Appendix A. Physical Demand Study Tests and Data

Table A1. Predictor tests utilized during the Physical Demands Study.

Ability	Tests	
Muscular strength	Isometric handgrip, Isometric 38 cm upright pull, Isometric bicep curl, squat dumbbell lift	
Muscular endurance	Sit-ups, push-ups, arm ergometer	
Power	Standing long jump, seated medicine ball put, overhead powerball throw, sled drag/exergenie drag ¹	
Speed and agility	Illinois agility test, 300 m sprint	
Cardiovascular endurance	20 m shuttle run (beep) test, loaded step test ²	

¹ This drag test was modified over time due to equipment failures.

² The loaded step test was experimental and dropped following the initial 12B validation study.

Table A2. Full contingency table for standing long jump for PDS Soldiers.

	Common MOSs			13B			19K			Combined		
Distance (cm)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
90	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
100	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
110	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
120	85%	14%	1%	71%	29%	0%	76%	24%	1%	87%	13%	0%
130	86%	13%	1%	72%	28%	0%	77%	22%	1%	87%	12%	1%
140	86%	11%	3%	73%	25%	1%	78%	18%	4%	87%	10%	2%
150	86%	9%	5%	76%	22%	2%	80%	14%	6%	88%	8%	4%
160	86%	6%	8%	80%	16%	4%	80%	9%	10%	88%	5%	7%
170	83%	4%	13%	81%	11%	8%	78%	7%	15%	85%	3%	12%
180	77%	2%	21%	76%	8%	17%	72%	2%	26%	77%	2%	21%
190	66%	1%	33%	73%	3%	24%	65%	1%	35%	66%	1%	33%
200	55%	1%	45%	71%	1%	28%	56%	1%	43%	56%	1%	44%
210	44%	0%	56%	64%	1%	36%	47%	1%	53%	45%	0%	55%
220	33%	0%	66%	52%	1%	48%	40%	1%	60%	34%	0%	66%
230	26%	0%	74%	45%	0%	55%	35%	1%	64%	26%	0%	73%
240	21%	0%	79%	37%	0%	63%	29%	1%	70%	20%	0%	79%
250	19%	0%	81%	33%	0%	67%	27%	1%	72%	17%	0%	82%
260	16%	0%	84%	31%	0%	69%	25%	1%	74%	15%	0%	85%
270	15%	0%	85%	30%	0%	70%	24%	0%	76%	14%	0%	86%
280	14%	0%	86%	29%	0%	71%	24%	0%	76%	13%	0%	87%
290	14%	0%	86%	29%	0%	71%	24%	0%	76%	13%	0%	87%

Figure A1. Standing long jump contingency table graphically displayed for PDS Soldiers. The vertical lines mark the current cut-scores for each of the MOS categories, but the data are all for black category combat arms MOSs.

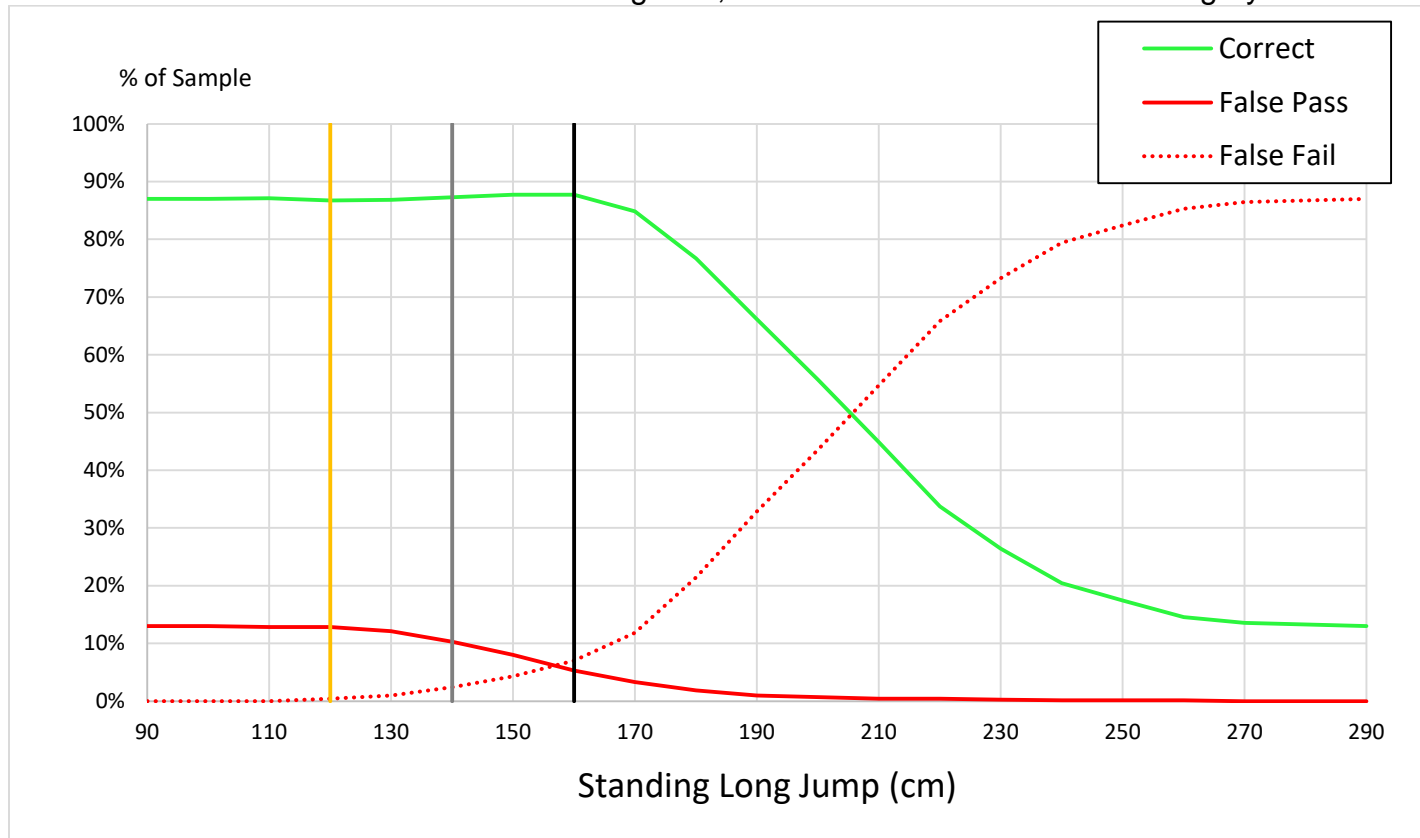


Table A3. Full contingency table for seated power throw for PDS Soldiers.

	Common MOSs			13B			19K			Combined		
Distance (cm)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
300	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
305	86%	14%	0%	72%	28%	0%	77%	23%	0%	87%	13%	0%
310	86%	14%	0%	72%	28%	0%	77%	23%	0%	87%	13%	0%
315	86%	14%	0%	72%	28%	0%	77%	23%	0%	88%	12%	0%
320	86%	14%	0%	72%	28%	0%	77%	23%	0%	87%	12%	0%
325	86%	14%	0%	72%	28%	0%	77%	23%	0%	87%	12%	0%
330	86%	14%	0%	72%	28%	0%	78%	22%	0%	88%	12%	0%
335	86%	13%	0%	72%	28%	0%	78%	22%	1%	88%	12%	0%
340	87%	13%	0%	73%	27%	0%	79%	21%	1%	88%	12%	0%
345	86%	13%	1%	73%	27%	0%	79%	20%	1%	88%	12%	0%
350	86%	13%	1%	73%	27%	0%	79%	20%	1%	88%	11%	1%
355	87%	12%	1%	74%	26%	0%	82%	17%	1%	89%	11%	1%
360	88%	11%	1%	74%	26%	0%	83%	16%	1%	89%	10%	1%
365	88%	11%	1%	74%	26%	0%	84%	15%	1%	90%	10%	1%
370	89%	10%	1%	76%	24%	0%	84%	14%	2%	90%	9%	1%
375	89%	9%	1%	76%	24%	0%	84%	13%	3%	90%	9%	1%
380	89%	9%	2%	76%	24%	0%	85%	11%	3%	91%	8%	1%
385	90%	8%	2%	76%	24%	0%	86%	10%	4%	91%	7%	2%
390	89%	8%	3%	77%	23%	0%	85%	10%	5%	91%	7%	2%
395	89%	8%	3%	77%	23%	0%	86%	9%	5%	91%	7%	2%
400	89%	7%	4%	79%	21%	0%	88%	8%	5%	91%	6%	3%
405	90%	6%	4%	81%	19%	0%	87%	7%	6%	92%	5%	3%
410	90%	5%	5%	83%	17%	0%	87%	6%	7%	92%	4%	4%
415	91%	4%	5%	83%	16%	1%	88%	5%	7%	92%	3%	4%
420	91%	4%	6%	84%	14%	1%	88%	5%	7%	92%	3%	4%
425	91%	3%	6%	85%	14%	1%	89%	4%	8%	93%	3%	5%
430	90%	3%	7%	85%	13%	2%	88%	3%	9%	92%	3%	5%
435	90%	3%	7%	87%	12%	2%	86%	3%	10%	92%	2%	6%
440	89%	2%	8%	86%	11%	3%	85%	3%	13%	91%	2%	7%
445	88%	2%	9%	86%	11%	3%	85%	2%	13%	90%	2%	8%
450	88%	2%	10%	88%	9%	3%	85%	2%	13%	90%	2%	8%
455	87%	2%	11%	88%	8%	3%	85%	1%	14%	90%	1%	9%
460	87%	1%	11%	88%	8%	4%	83%	1%	16%	89%	1%	10%
465	88%	1%	11%	88%	8%	4%	83%	1%	16%	89%	1%	10%
470	88%	1%	11%	89%	7%	4%	81%	1%	18%	89%	1%	10%
475	88%	1%	11%	89%	7%	4%	79%	1%	20%	88%	1%	11%
480	87%	1%	12%	88%	7%	4%	78%	1%	21%	88%	1%	11%
485	87%	1%	12%	88%	7%	4%	77%	1%	22%	87%	1%	12%

Table A3 (continued). Full contingency table for seated power throw for PDS Soldiers.

	Common MOSs			13B			19K			Combined		
Distance (cm)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
490	86%	1%	13%	88%	7%	5%	75%	1%	24%	86%	1%	13%
495	85%	1%	14%	87%	7%	6%	74%	1%	25%	85%	1%	14%
460	85%	1%	14%	87%	7%	6%	74%	1%	25%	85%	1%	14%
465	84%	1%	16%	88%	6%	6%	73%	1%	27%	84%	1%	15%
470	83%	1%	16%	87%	6%	7%	71%	1%	29%	83%	1%	16%
475	83%	1%	17%	87%	6%	8%	70%	1%	30%	82%	1%	17%
480	81%	1%	18%	86%	6%	8%	68%	1%	32%	81%	1%	18%
485	80%	1%	19%	85%	6%	9%	66%	1%	33%	80%	1%	20%
490	79%	1%	20%	85%	5%	10%	65%	1%	34%	79%	1%	21%
495	78%	1%	21%	84%	5%	11%	65%	1%	35%	78%	1%	22%
500	76%	1%	23%	83%	4%	13%	63%	1%	36%	76%	1%	23%
505	75%	0%	24%	83%	4%	13%	61%	1%	39%	75%	1%	25%
510	75%	0%	25%	82%	4%	14%	60%	1%	39%	74%	1%	26%
515	74%	0%	26%	81%	4%	15%	58%	1%	42%	72%	1%	27%
520	72%	0%	27%	82%	3%	15%	58%	1%	42%	71%	0%	28%
525	71%	0%	29%	82%	3%	16%	57%	1%	42%	70%	0%	30%
530	70%	0%	30%	83%	2%	16%	55%	1%	45%	69%	0%	31%
535	69%	0%	31%	82%	1%	17%	55%	1%	45%	68%	0%	32%
540	87%	1%	11%	88%	8%	4%	83%	1%	16%	89%	1%	10%
545	88%	1%	11%	88%	8%	4%	83%	1%	16%	89%	1%	10%
550	88%	1%	11%	89%	7%	4%	81%	1%	18%	89%	1%	10%
555	88%	1%	11%	89%	7%	4%	79%	1%	20%	88%	1%	11%
560	87%	1%	12%	88%	7%	4%	78%	1%	21%	88%	1%	11%
565	87%	1%	12%	88%	7%	4%	77%	1%	22%	87%	1%	12%
570	86%	1%	13%	88%	7%	5%	75%	1%	24%	86%	1%	13%
575	85%	1%	14%	87%	7%	6%	74%	1%	25%	85%	1%	14%
580	67%	0%	32%	82%	1%	17%	53%	1%	46%	66%	0%	33%
585	66%	0%	34%	81%	1%	18%	53%	1%	46%	65%	0%	35%
590	65%	0%	35%	81%	1%	18%	51%	1%	48%	64%	0%	36%
595	63%	0%	36%	78%	1%	21%	50%	1%	49%	62%	0%	38%
600	62%	0%	37%	77%	1%	22%	49%	1%	50%	61%	0%	39%
605	60%	0%	40%	76%	1%	23%	48%	1%	51%	59%	0%	41%
610	57%	0%	43%	72%	1%	27%	48%	1%	52%	56%	0%	43%
615	56%	0%	44%	72%	1%	28%	46%	1%	54%	55%	0%	45%
620	54%	0%	46%	68%	1%	31%	45%	1%	54%	53%	0%	47%
625	53%	0%	47%	68%	0%	32%	45%	1%	54%	52%	0%	48%
630	51%	0%	49%	66%	0%	34%	43%	1%	56%	50%	0%	50%
635	48%	0%	51%	66%	0%	34%	43%	1%	57%	48%	0%	52%

Table A3 (continued). Full contingency table for seated power throw for PDS Soldiers.

	Common MOSs			13B			19K			Combined		
Distance (cm)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
640	46%	0%	53%	66%	0%	34%	42%	1%	57%	47%	0%	53%
645	44%	0%	56%	64%	0%	36%	41%	1%	59%	44%	0%	55%
650	42%	0%	58%	62%	0%	38%	40%	1%	59%	43%	0%	57%
655	41%	0%	59%	60%	0%	40%	39%	1%	60%	41%	0%	59%
660	40%	0%	60%	60%	0%	40%	38%	1%	62%	40%	0%	60%

Figure A2. Seated power throw contingency table graphically displayed for PDS Soldiers. The vertical lines mark the current cut-scores for each of the MOS categories, but the data are all for black category combat arms MOSs.

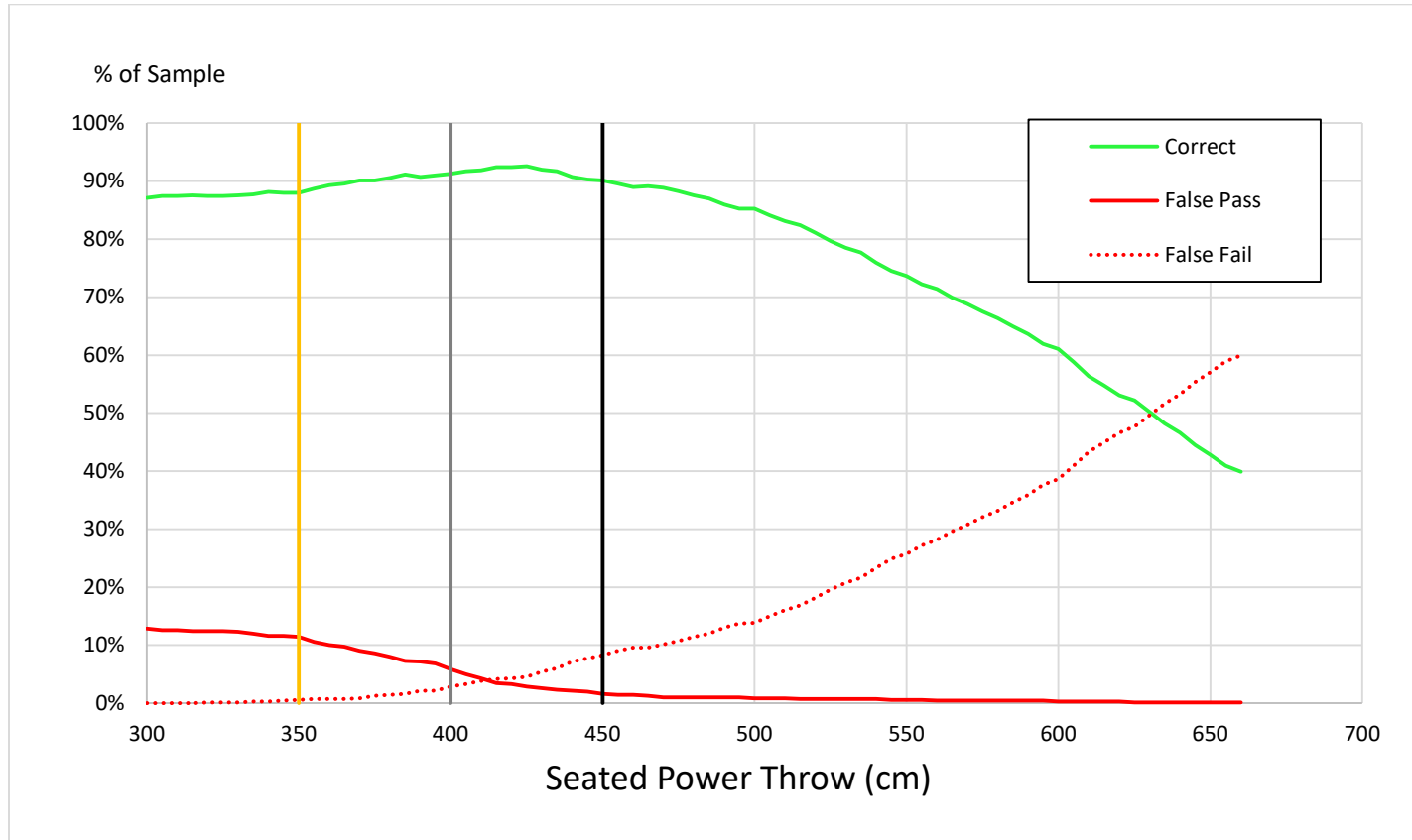


Table A4. Full contingency table for strength deadlift for PDS Soldiers.

	Common MOSs			13B			19K			Combined		
Load (lbs.)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
0	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
60	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
100	86%	14%	0%	71%	29%	0%	77%	23%	0%	87%	13%	0%
140	90%	8%	2%	82%	18%	1%	85%	14%	1%	92%	7%	2%
180	87%	2%	11%	90%	6%	4%	85%	4%	11%	88%	2%	10%
220	78%	1%	22%	78%	2%	19%	75%	1%	24%	78%	1%	22%

Figure A3. Strength deadlift contingency table graphically displayed for PDS Soldiers. The vertical lines mark the current cut-scores for each of the MOS categories, but the data are all for black category combat arms MOSs.

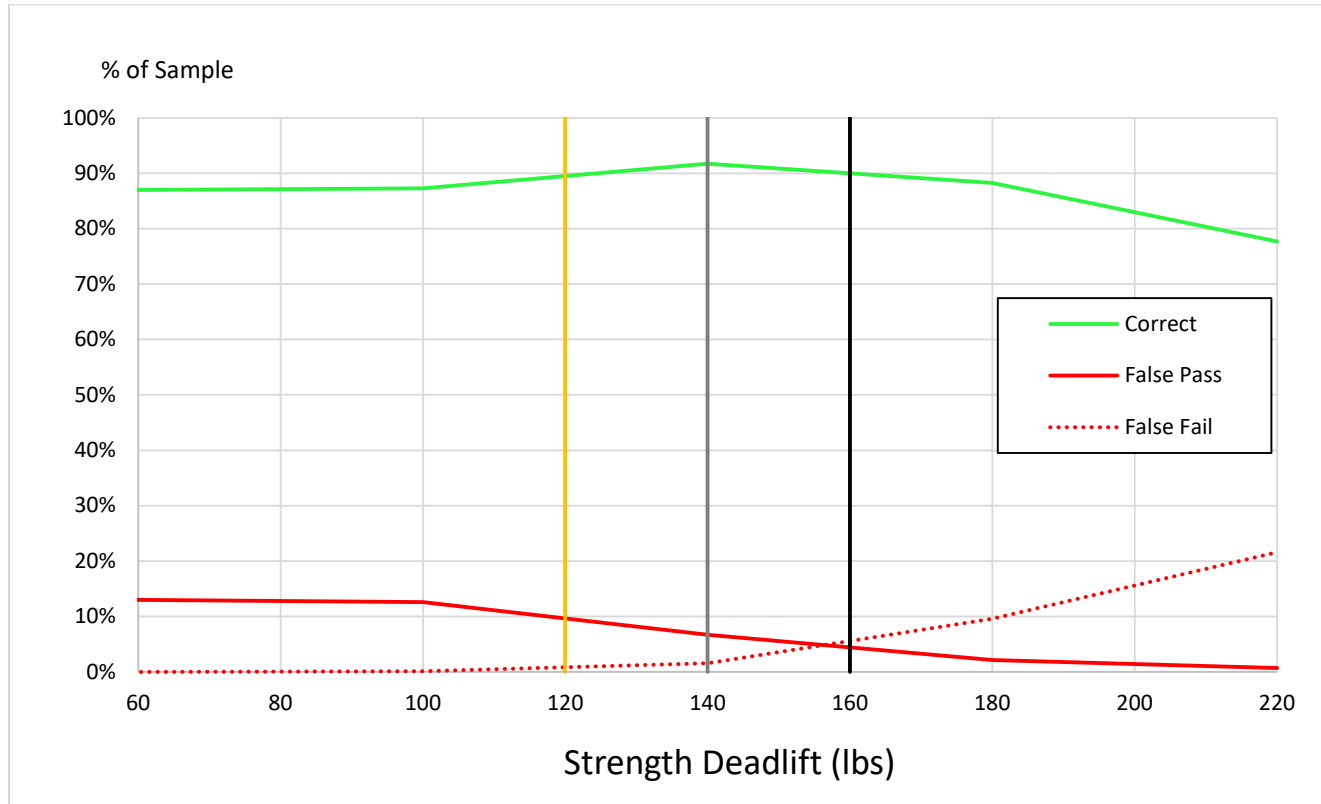


Table A5. Full contingency table for interval aerobic run for PDS Soldiers.

	Common MOSs			13B			19K			Combined		
Shuttles	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
10	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
11	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
12	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
13	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
14	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
15	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
16	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
17	86%	14%	0%	71%	29%	0%	76%	24%	0%	87%	13%	0%
18	86%	14%	0%	71%	29%	0%	76%	24%	1%	87%	13%	0%
19	86%	14%	0%	71%	29%	0%	76%	24%	1%	87%	13%	0%
20	86%	14%	0%	71%	29%	0%	76%	24%	1%	87%	13%	0%
21	86%	14%	1%	71%	29%	0%	76%	24%	1%	87%	13%	0%
22	86%	13%	1%	71%	29%	0%	76%	23%	1%	87%	12%	0%
23	86%	13%	1%	72%	28%	0%	76%	23%	1%	87%	12%	1%
24	86%	13%	1%	72%	28%	0%	75%	23%	2%	87%	12%	1%
25	86%	13%	1%	73%	27%	0%	76%	22%	2%	87%	12%	1%
26	87%	12%	1%	73%	27%	0%	76%	22%	2%	87%	12%	1%
27	86%	12%	2%	73%	27%	0%	76%	22%	2%	87%	11%	1%
28	86%	12%	2%	74%	26%	0%	76%	22%	3%	87%	11%	2%
29	85%	12%	3%	74%	26%	0%	76%	22%	3%	87%	11%	2%
30	85%	12%	3%	75%	25%	0%	76%	22%	3%	87%	11%	2%
31	85%	11%	4%	76%	24%	0%	75%	22%	3%	87%	11%	3%
32	85%	11%	4%	76%	24%	0%	76%	21%	3%	87%	10%	3%
33	86%	10%	4%	77%	23%	0%	76%	21%	3%	87%	10%	3%
34	85%	10%	5%	78%	21%	1%	77%	19%	4%	87%	9%	4%
35	84%	10%	6%	79%	21%	1%	77%	18%	4%	86%	9%	5%
36	84%	9%	7%	79%	21%	1%	78%	18%	4%	86%	9%	5%
37	83%	9%	8%	79%	21%	1%	79%	17%	4%	85%	9%	6%
38	82%	9%	9%	78%	20%	2%	80%	15%	5%	85%	8%	7%
39	82%	8%	9%	79%	19%	2%	79%	15%	7%	85%	8%	7%
40	82%	8%	11%	80%	18%	2%	80%	14%	7%	85%	7%	8%
41	81%	7%	12%	79%	17%	4%	80%	13%	7%	84%	7%	9%
42	81%	7%	13%	79%	15%	6%	80%	13%	7%	83%	7%	10%
43	77%	6%	17%	78%	15%	7%	80%	9%	11%	81%	5%	13%
44	77%	6%	17%	78%	15%	7%	79%	8%	13%	81%	5%	14%
45	76%	5%	19%	79%	14%	7%	79%	8%	13%	80%	5%	15%
46	73%	5%	22%	78%	13%	9%	79%	8%	13%	78%	5%	17%
47	72%	5%	23%	77%	12%	11%	80%	7%	13%	78%	4%	18%

Table A5 (continued). Full contingency table for interval aerobic run for PDS Soldiers.

	Common MOSs			13B			19K			Combined		
Shuttles	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
48	71%	5%	24%	77%	12%	11%	79%	7%	14%	77%	4%	19%
49	69%	5%	26%	76%	12%	12%	79%	7%	15%	75%	4%	21%
50	67%	4%	29%	74%	11%	15%	78%	6%	16%	73%	4%	23%
51	66%	4%	30%	71%	11%	19%	79%	4%	17%	72%	3%	25%
52	65%	4%	31%	71%	10%	19%	79%	3%	18%	71%	3%	26%
53	60%	3%	37%	71%	7%	22%	76%	3%	21%	66%	3%	31%
54	58%	3%	39%	67%	6%	28%	73%	3%	24%	63%	2%	34%
55	56%	3%	42%	65%	5%	30%	72%	3%	25%	61%	2%	36%
56	54%	2%	43%	65%	4%	31%	71%	2%	27%	59%	2%	38%
57	52%	2%	45%	64%	4%	31%	71%	1%	28%	58%	2%	40%
58	51%	2%	47%	64%	3%	33%	70%	1%	29%	57%	2%	41%
59	49%	2%	49%	62%	3%	35%	68%	1%	30%	55%	2%	44%
60	47%	2%	51%	61%	3%	36%	67%	1%	32%	53%	2%	45%
61	46%	2%	53%	61%	2%	37%	67%	1%	32%	52%	1%	46%
62	45%	2%	53%	59%	2%	38%	67%	1%	32%	52%	1%	47%
63	43%	1%	55%	54%	2%	44%	64%	1%	35%	48%	1%	51%
64	41%	1%	58%	52%	2%	47%	65%	1%	35%	46%	1%	53%
65	40%	1%	59%	52%	2%	47%	63%	1%	37%	45%	1%	54%
66	39%	1%	60%	52%	1%	47%	61%	1%	38%	44%	1%	55%
67	38%	1%	61%	49%	1%	49%	60%	1%	40%	43%	1%	57%
68	37%	1%	62%	49%	1%	49%	58%	1%	41%	41%	1%	58%
69	36%	1%	63%	48%	1%	51%	56%	1%	43%	40%	1%	59%
70	35%	1%	64%	47%	0%	53%	54%	1%	45%	39%	0%	61%
71	33%	1%	66%	47%	0%	53%	53%	1%	47%	37%	0%	63%
72	32%	1%	67%	47%	0%	53%	52%	1%	47%	36%	0%	64%
73	31%	1%	69%	46%	0%	54%	50%	1%	49%	34%	0%	65%
74	27%	1%	72%	43%	0%	57%	48%	1%	52%	31%	0%	69%
75	27%	0%	73%	41%	0%	59%	47%	0%	53%	30%	0%	70%
76	26%	0%	74%	41%	0%	59%	46%	0%	54%	29%	0%	71%
77	25%	0%	75%	41%	0%	59%	45%	0%	55%	28%	0%	72%
78	24%	0%	76%	39%	0%	61%	43%	0%	57%	27%	0%	73%
79	23%	0%	76%	39%	0%	61%	42%	0%	58%	26%	0%	74%
80	23%	0%	76%	39%	0%	61%	42%	0%	58%	26%	0%	74%
81	22%	0%	78%	38%	0%	62%	42%	0%	58%	24%	0%	75%
82	22%	0%	78%	38%	0%	62%	41%	0%	59%	24%	0%	76%
83	21%	0%	79%	37%	0%	63%	41%	0%	59%	23%	0%	76%
84	20%	0%	80%	36%	0%	64%	38%	0%	62%	22%	0%	78%
85	19%	0%	80%	35%	0%	65%	37%	0%	63%	21%	0%	79%

Table A5 (continued). Full contingency table for interval aerobic run for PDS Soldiers.

	Common MOSs			13B			19K			Combined		
Shuttles	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
86	19%	0%	80%	33%	0%	67%	36%	0%	64%	20%	0%	79%
87	19%	0%	81%	33%	0%	67%	35%	0%	65%	20%	0%	80%
88	19%	0%	81%	33%	0%	67%	35%	0%	65%	19%	0%	80%
89	19%	0%	81%	33%	0%	67%	35%	0%	65%	20%	0%	80%
90	18%	0%	82%	33%	0%	67%	34%	0%	66%	19%	0%	81%
91	18%	0%	82%	33%	0%	67%	34%	0%	66%	18%	0%	81%
92	17%	0%	83%	32%	0%	68%	33%	0%	67%	18%	0%	82%
93	17%	0%	83%	32%	0%	68%	33%	0%	67%	18%	0%	82%
94	17%	0%	83%	32%	0%	68%	32%	0%	68%	17%	0%	83%
95	16%	0%	84%	31%	0%	69%	30%	0%	70%	16%	0%	84%
96	15%	0%	85%	31%	0%	69%	29%	0%	71%	15%	0%	85%
97	15%	0%	85%	31%	0%	69%	28%	0%	72%	15%	0%	85%
98	15%	0%	85%	30%	0%	70%	27%	0%	73%	14%	0%	86%
99	14%	0%	85%	30%	0%	70%	26%	0%	74%	14%	0%	86%
100	14%	0%	85%	30%	0%	70%	26%	0%	74%	14%	0%	86%

Figure A4. Interval aerobic run contingency table graphically displayed for PDS Soldiers. The vertical lines mark the current cut-scores for each of the MOS categories, but the data are all for black category combat MOS.



Appendix B.

Table B1. Detailed testing schedule for OPAT study to include locations, dates and number of volunteers.

Location	MOS	OPAT Date (2016)	Subjects (n)		Corresponding HPDT Date (2016)	Subjects (n)		Corresponding FM Date (2016)	Subjects (n)		
			M	F		M	F		M	F	
							Common Tasks	MOS Tasks ¹			
Ft. Benning	19K	JAN 19-24	137		APR 6-10	89			MAY 3	77	
		APR 21-23	72		JUL 11-15	44			JUL 11-15	44	
		JUN 16-18	37		SEPT 25-28	32			SEPT 26-29	32	
		AUG 25-27	45		DEC 5-9	20			DEC 5-9	20	
		Total:	291		Total:	185			Total:	173	
	19D	FEB 25-27	100		JUN 20-23	58			JUN 25	58	
	11C	FEB 25-27	65		MAY 4-6	45			MAY 18	40	
11B	APR 21-23	95		JUL 11-15	61			JUL 11-15	61		
Ft. Leonard-Wood	12B ²	APR 25-27	85	15	JUL 10-14	69	6	Not Required	JUL 10-14	69	6
	"19K" Women ³	APR 25-27		26	JUL 10-14		19	16	JUL 10-14		19
		MAY 14-17		58	AUG 1-5		31	30	AUG 1-5		31
		Total:		84	Total:		50	46	Total:		50
Ft. Sill	13B	FEB 24-28	90		MAY 22-27	63			Not Required to complete FM		
		MAR 10-13	23		JUN 5-9	17					
		APR 7-10	79		JUL 5-9	39					
		JUN 2-5	85		AUG 14-19	62					
		Total:	277		Total:	181					
	13F	FEB 24-28	7		MAY 22-27	0			MAY 22-27	0	
		MAR 10-13	27		JUN 5-9	20			JUN 5-9	20	
		APR 7-10	3		JUL 5-9	3			JUL 5-9	3	
		JUN 2-5	2		AUG 14-19	0			AUG 14-19	0	
		Total:	39		Total:	23			Total:	23	
	"13B" Women ⁴	FEB 24-28		17	MAY 22-27		5	2	MAY 22-27		2
		MAR 10-13		10	JUN 5-9		4	4	JUN 5-9		4
		APR 7-10		23	JUL 5-9		8	6	JUL 5-9		6
		JUN 2-5		14	AUG 14-19		6	6	AUG 14-19		6
		JUL 21-24		36	OCT 16-21		25	Not Required	Not Required to complete FM		
		AUG 19-20		38	NOV 6-10		28	Not Required			
		Total:		138	Total:		148	18	Total:		18

¹Acting 19K women participated in the Stow Ammo and Load Main Gun as their MOS-specific tasks; acting 13B women participated in Transfer Ammo with a FAASV and Casualty Drag as their MOS specific tasks ²12B women were tested with 12B men. ³Acting 19K women were recruited from other physically demanding MOS: 12/31/74/88 series. ⁴Acting 13B women were recruited from other physically demanding MOS's: 13/14 series; 13B women were tested with other 13/14 series women, ⁵NR=Not Required

Table B2. OPAT and CMTS Scores (mean, standard deviation [SD], and sample size [n]) by MOS (men) and Location (women).

		IAR (shuttles)	SPT (m)	SLJ (cm)	SDL (lbs.)	Foot march (min)	Sand- bag (min)	Move Under Fire (min)	Casualty Evac. (lbs.)	Casualty Drag (m/s)	FAASV (rounds /min)	Load Main Gun (sec)	Stow Ammo (rounds /min)
11B	Mean	63.2	6.2	210.5	215.4	65.6	1.9	2.2	176.2	0.9	---	---	---
	SD	15.8	0.9	27.2	14.8	4.4	0.3	0.3	33.2	0.2	---	---	---
	N	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	---	---	---
11C	Mean	65.2	6.5	205.2	216.0	64.3	2.1	2.3	193.5	0.7	---	---	---
	SD	16.5	0.8	26.2	12.2	3.7	0.3	0.1	34.7	0.3	---	---	---
	N	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	---	---	---
12B	Mean	57.4	5.9	197.2	210.9	63.7	2.0	2.4	186.4	0.7	---	---	---
	SD	18.3	0.9	29.0	21.4	4.7	0.3	0.2	34.7	0.3	---	---	---
	N	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	---	---	---
13B	Mean	57.0	5.8	200.3	215.7	---	---	---	---	0.6	3.1	---	---
	SD	18.1	0.7	30.8	16.1	---	---	---	---	0.3	1.3	---	---
	N	184.0	184.0	184.0	184.0	---	---	---	---	184.0	184.0	---	---
13F	Mean	61.0	5.9	194.6	214.8	66.9	2.3	2.2	177.8	0.8	---	---	---
	SD	15.8	1.1	29.7	13.8	5.7	0.5	0.1	45.3	0.4	---	---	---
	N	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	---	---	---
19D	Mean	57.4	5.9	196.9	209.0	61.9	2.2	2.3	188.4	0.8	---	---	---
	SD	16.2	0.9	26.5	24.6	3.6	0.5	0.2	39.8	0.3	---	---	---
	N	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	---	---	---
19K	Mean	54.6	6.0	197.6	214.5	68.3	---	2.4	190.7	0.8	---	21.3	7.1
	SD	17.0	0.7	30.8	18.0	7.1	---	0.2	30.4	0.3	---	4.3	1.6
	N	173.0	173.0	173.0	173.0	173.0	---	173.0	173.0	173.0	---	173.0	173.0
Ft Leonard Wood Women	Mean	31.9	4.0	150.2	168.0	72.5	3.1	2.7	110.4	0.1	---	26.2	3.3
	SD	12.9	0.5	23.9	34.5	5.8	0.8	0.3	28.9	0.2	---	5.5	1.7
	N	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	47.0	---	48.0	49.0
Ft Sill Women	Mean	37.3	3.8	151.9	159.7	78.9	4.0	2.7	114.6	0.2	1.0	---	---
	SD	14.8	0.5	24.1	33.5	10.2	1.6	0.3	41.2	0.2	0.7	---	---
	N	77.0	77.0	77.0	77.0	18.0	24.0	24.0	24.0	77.0	76.0	---	---

Table B3. Breakdown of OPAT performance by passing level.

	All individuals who completed OPAT			Individuals who completed all tasks of at least one MOS		
	Male (n=949)	Female (n=233)	Combined (n=1182)	Male (n=608)	Female (n=133)	Combined (n=741)
ALL four OPAT events						
Black (Heavy)	67.4%	6.9%	55.5%	72.9%	7.5%	59.6%
Gray (Significant)	13.2%	9.0%	12.4%	12.2%	12.0%	12.4%
Gold (Moderate)	6.7%	16.7%	8.7%	5.3%	21.8%	9.0%
White (Not ready)	12.6%	67.4%	23.4%	9.7%	58.6%	18.9%
Standing Long Jump						
Black (Heavy)	90.5%	30.5%	78.7%	91.6%	37.6%	81.9%
Gray (Significant)	6.7%	30.5%	11.4%	6.4%	28.6%	10.4%
Gold (Moderate)	2.5%	29.6%	7.9%	1.8%	27.8%	6.5%
White (Not ready)	0.2%	9.4%	2.0%	0.2%	6.0%	1.2%
Seated Power Throw						
Black (Heavy)	97.9%	16.3%	81.8%	98.8%	15.0%	83.8%
Gray (Significant)	1.8%	25.3%	6.4%	0.8%	27.8%	5.7%
Gold (Moderate)	0.3%	39.9%	8.1%	0.3%	40.6%	7.6%
White (Not ready)	0.0%	18.5%	3.6%	0.0%	3.0%	3.0%
Strength Deadlift						
Black (Heavy)	96.5%	54.5%	88.2%	96.6%	54.9%	89.3%
Gray (Significant)	2.6%	33.5%	8.7%	3.0%	35.3%	8.8%
Gold (Moderate)	NT	NT	NT	NT	NT	NT
White (Not ready)	0.8%	12.0%	3.0%	0.2%	9.8%	1.9%
Interval Aerobic Run						
Black (Heavy)	73.0%	21.0%	62.8%	79.4%	27.1%	70.0%
Gray (Significant)	9.2%	7.7%	8.9%	6.9%	11.3%	7.7%
Gold (Moderate)	5.6%	9.9%	6.4%	4.1%	10.5%	5.2%
White (Not ready)	12.2%	61.4%	21.9%	9.5%	51.1%	70.0%

NT: Not Tested

Table B4. Correlations between body size, OPAT events and CMTSs for all recruit men who completed all tests.

		Height (cm)	Mass (kg)	BMI	IAR (shuttles)	SPT (m)	SLJ (cm)	SDL (lbs.)	Foot march (min)	Sandbag Carry (min)	Move Under Fire (min)	Casualty Evac (lbs.)	Casualty Drag (m/s)	FAASV (rds/min)	Load Main Gun (sec)	Stow Ammo (rds/min)
Height (cm)	r	1	.435**	-.004	.026	.318**	.096*	.103*	-.237**	-.313**	-.045	.143**	.322**	.274**	-.122	.285**
	n	607	607	607	607	607	607	607	423	250	423	423	607	184	173	173
Mass (kg)	r	.435**	1	.896**	-.276**	.470**	-.129**	.285**	-.119*	-.323**	.028	.397**	.416**	.365**	-.272**	.441**
	n	607	608	607	608	608	608	608	424	251	424	424	608	184	173	173
BMI	r	-.004	.896**	1	-.321**	.365**	-.192**	.277**	-.019	-.230**	.055	.382**	.308**	.258**	-.263**	.385**
	n	607	607	607	607	607	607	607	423	250	423	423	607	184	173	173
Interval Aerobic Run (shuttles)	r	.026	-.276**	-.321**	1	.126**	.419**	.128**	-.303**	-.219**	-.288**	.142**	.190**	.218**	-.047	-.074
	n	607	608	607	608	608	608	608	424	251	424	424	608	184	173	173
Seated Power Throw (m)	r	.318**	.470**	.365**	.126**	1	.406**	.310**	-.265**	-.399**	-.220**	.404**	.559**	.430**	-.360**	.429**
	n	607	608	607	608	608	608	608	424	251	424	424	608	184	173	173
Standing Long Jump (cm)	r	.096*	-.129**	-.192**	.419**	.406**	1	.234**	-.267**	-.411**	-.348**	.247**	.363**	.309**	-.171*	.018
	n	607	608	607	608	608	608	608	424	251	424	424	608	184	173	173
Strength Deadlift (lbs.)	r	.103*	.285**	.277**	.128**	.310**	.234**	1	-.069	-.340**	-.121*	.458**	.349**	.298**	-.242**	.202**
	n	607	608	607	608	608	608	608	424	251	424	424	608	184	173	173
Foot march Time (min)	r	-.237**	-.119*	-.019	-.303**	-.265**	-.267**	-.069	1	.327**	.116*	-.163**	-.265**	. ^c	.087	-.097
	n	423	424	423	424	424	424	424	424	251	424	424	424	0	173	173
Sandbag Time (min)	r	-.313**	-.323**	-.230**	-.219**	-.399**	-.411**	-.340**	.327**	1	.330**	-.405**	-.561**	. ^c	. ^c	. ^c
	n	250	251	250	251	251	251	251	251	251	251	251	251	0	0	0
Move Under Fire Time (min)	r	-.045	.028	.055	-.288**	-.220**	-.348**	-.121*	.116*	.330**	1	-.221**	-.292**	. ^c	.367**	-.297**
	n	423	424	423	424	424	424	424	424	251	424	424	424	0	173	173
Casualty Evac Weight (lbs.)	r	.143**	.397**	.382**	.142**	.404**	.247**	.458**	-.163**	-.405**	-.221**	1	.450**	. ^c	-.397**	.382**
	n	423	424	423	424	424	424	424	424	251	424	424	424	0	173	173
Casualty Drag Speed (m/s)	r	.322**	.416**	.308**	.190**	.559**	.363**	.349**	-.265**	-.561**	-.292**	.450**	1	.580**	-.459**	.469**
	n	607	608	607	608	608	608	608	424	251	424	424	608	184	173	173

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Cannot be computed because at least one of the variables is constant.

Table B4 (cont'd). Correlations between body size, OPAT events and CMTSs for recruit men who completed all tests

	Height (cm)	Mass (kg)	BMI	IAR (shuttles)	SPT (m)	SLJ (cm)	SDL (lbs.)	Foot march (min)	Sandbag Carry (min)	Move Under Fire (min)	Casualty Evac (lbs.)	Casualty Drag (m/s)	FAASV (rds/min)	Load Main Gun (sec)	Stow Ammo (rds/min)
FAASV Load Rate (rounds/min)															
r	.274**	.365**	.258**	.218**	.430**	.309**	.298**	. ^c	. ^c	. ^c	. ^c	.580**	1	. ^c	. ^c
n	184	184	184	184	184	184	184	0	0	0	0	184	184	0	0
Load Main Gun Time (sec)															
r	-.122	-.272**	-.263**	-.047	-.360**	-.171*	-.242**	.087	. ^c	.367**	-.397**	-.459**	. ^c	1	-.654**
n	173	173	173	173	173	173	173	173	0	173	173	173	0	173	173
Stow Ammo Rate (rounds/min)															
r	.285**	.441**	.385**	-.074	.429**	.018	.202**	-.097	. ^c	-.297**	.382**	.469**	. ^c	-.654**	1
n	173	173	173	173	173	173	173	173	0	173	173	173	0	173	173

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Cannot be computed because at least one of the variables is constant.

Table B5. Correlations between body size, OPAT Events and CMTSs for recruit women who completed all tests.

		Height (cm)	Mass (kg)	BMI	IAR (shuttles)	SPT (m)	SLJ (cm)	SDL (lbs.)	Foot march (min)	Sandbag Carry (min)	Move Under Fire (min)	Casualty Evac (lbs.)	Casualty Drag (m/s)	FAASV (rds/min)	Load Main Gun (sec)	Stow Ammo (rds/min)
Height (cm)	r	1	.491**	-.055	.049	.446**	.195*	.201*	-.220	-.311**	-.129	.300**	.211*	.297**	-.284	.390**
	N	133	133	133	133	133	133	133	74	80	80	80	130	76	48	49
Mass (kg)	r	.491**	1	.828**	-.055	.458**	.017	.420**	-.162	-.504**	-.082	.460**	.412**	.269*	-.310*	.546**
	N	133	133	133	133	133	133	133	74	80	80	80	130	76	48	49
BMI	r	-.055	.828**	1	-.109	.246**	-.114	.357**	-.045	-.391**	-.008	.349**	.342**	.129	-.173	.368**
	N	133	133	133	133	133	133	133	74	80	80	80	130	76	48	49
Interval Aerobic Run (shuttles)	r	.049	-.055	-.109	1	.280**	.453**	.295**	-.278*	-.233*	-.434**	.448**	.365**	.425**	-.336*	.375**
	N	133	133	133	133	133	133	133	74	80	80	80	130	76	48	49
Seated Power Throw (m)	r	.446**	.458**	.246**	.280**	1	.525**	.562**	-.430**	-.426**	-.303**	.583**	.332**	.349**	-.457**	.600**
	N	133	133	133	133	133	133	133	74	80	80	80	130	76	48	49
Standing Long Jump (cm)	r	.195*	.017	-.114	.453**	.525**	1	.415**	-.353**	-.137	-.318**	.458**	.168	.401**	-.423**	.352*
	N	133	133	133	133	133	133	133	74	80	80	80	130	76	48	49
Strength Deadlift (lbs.)	r	.201*	.420**	.357**	.295**	.562**	.415**	1	-.408**	-.335**	-.330**	.628**	.445**	.428**	-.405**	.614**
	N	133	133	133	133	133	133	133	74	80	80	80	130	76	48	49
Foot march Time (min)	r	-.220	-.162	-.045	-.278*	-.430**	-.353**	-.408**	1	.298*	.207	-.427**	-.305**	.060	.332*	-.442**
	N	74	74	74	74	74	74	74	74	74	74	74	71	17	48	49
Sandbag Time (min)	r	-.311**	-.504**	-.391**	-.233*	-.426**	-.137	-.335**	.298*	1	.176	-.364**	-.390**	-.633**	.273	-.519**
	N	80	80	80	80	80	80	80	74	80	80	80	77	23	48	49
Move Under Fire Time (min)	r	-.129	-.082	-.008	-.434**	-.303**	-.318**	-.330**	.207	.176	1	-.493**	-.318**	-.522*	.157	-.137
	N	80	80	80	80	80	80	80	74	80	80	80	77	23	48	49
Casualty Evac Weight (lbs.)	r	.300**	.460**	.349**	.448**	.583**	.458**	.628**	-.427**	-.364**	-.493**	1	.631**	.552**	-.389**	.531**
	N	80	80	80	80	80	80	80	74	80	80	80	77	23	48	49
Casualty Drag Speed (m/s)	r	.211*	.412**	.342**	.365**	.332**	.168	.445**	-.305**	-.390**	-.318**	.631**	1	.220	-.349*	.447**
	N	130	130	130	130	130	130	130	71	77	77	77	130	76	46	47

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Cannot be computed due to insufficient data.

Table B5 (cont'd). Correlations between body size, OPAT Events and CMTSs for recruit women who completed all tests

		Height (cm)	Mass (kg)	BMI	IAR (shuttles)	SPT (m)	SLJ (cm)	SDL (lbs.)	Foot march (min)	Sandbag Carry (min)	Move Under Fire (min)	Casualty Evac (lbs.)	Casualty Drag (m/s)	FAASV (rds/min)	Load Main Gun (sec)	Stow Ammo (rds/min)
FAASV Load Rate (rounds/min)	r	.297**	.269*	.129	.425**	.349**	.401**	.428**	.060	-.633**	-.522*	.552**	.220	1	. ^c	. ^c
	N	76	76	76	76	76	76	76	17	23	23	23	76	76	0	0
Load Main Gun Time (sec)	r	-.284	-.310*	-.173	-.336*	-.457**	-.423**	-.405**	.332*	.273	.157	-.389**	-.349*	. ^c	1	-.588**
	N	48	48	48	48	48	48	48	48	48	48	48	46	0	48	48
Stow Ammo (rounds/min)	r	.390**	.546**	.368**	.375**	.600**	.352*	.614**	-.442**	-.519**	-.137	.531**	.447**	. ^c	-.588**	1
	N	49	49	49	49	49	49	49	49	49	49	49	47	0	48	49

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Cannot be computed due to insufficient data. Women did either the FAASV task or the Armor tasks. No women performed both.

Table B6. Full contingency table for standing long jump for OPAT recruits.

	Common MOSs			13B			19K			Combined		
Distance (cm)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
90	74%	26%	0%	52%	48%	0%	76%	24%	0%	67%	33%	0%
100	74%	26%	0%	52%	48%	0%	76%	24%	0%	68%	32%	0%
110	74%	26%	0%	52%	48%	0%	76%	24%	0%	68%	32%	0%
120	76%	24%	0%	53%	47%	0%	77%	22%	0%	69%	31%	0%
130	77%	22%	0%	57%	43%	1%	79%	20%	1%	71%	28%	1%
140	78%	20%	2%	60%	38%	2%	81%	18%	1%	73%	25%	2%
150	81%	15%	3%	65%	33%	3%	84%	12%	4%	77%	20%	3%
160	80%	14%	6%	69%	28%	3%	81%	11%	8%	77%	17%	6%
170	78%	10%	12%	75%	19%	6%	77%	8%	15%	77%	12%	11%
180	78%	6%	15%	76%	15%	10%	71%	5%	24%	75%	9%	16%
190	73%	5%	22%	72%	12%	16%	64%	4%	32%	70%	7%	23%
200	65%	3%	32%	71%	8%	21%	54%	4%	42%	64%	5%	31%
210	54%	2%	44%	65%	5%	30%	47%	2%	51%	56%	3%	42%
220	45%	1%	54%	58%	3%	38%	43%	0%	57%	49%	1%	50%
230	37%	0%	62%	57%	2%	41%	36%	0%	64%	43%	1%	56%
240	32%	0%	68%	53%	1%	46%	30%	0%	70%	38%	0%	61%
250	29%	0%	71%	50%	1%	49%	28%	0%	72%	35%	0%	64%
260	27%	0%	73%	50%	0%	50%	26%	0%	74%	34%	0%	66%
270	27%	0%	73%	50%	0%	50%	25%	0%	75%	34%	0%	66%
280	26%	0%	74%	49%	0%	51%	24%	0%	76%	33%	0%	67%
290	26%	0%	74%	48%	0%	52%	24%	0%	76%	33%	0%	67%

Table B7. Full contingency table for seated power throw for OPAT recruits.

	Common MOSs			13B			19K			Combined		
Distance (cm)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
300	74%	26%	0%	52%	48%	0%	76%	24%	0%	67%	33%	0%
305	74%	26%	0%	53%	47%	0%	76%	24%	0%	68%	32%	0%
310	74%	26%	0%	53%	47%	0%	76%	24%	0%	68%	32%	0%
315	74%	26%	0%	55%	45%	0%	76%	24%	0%	69%	31%	0%
320	74%	26%	0%	55%	45%	0%	76%	24%	0%	69%	31%	0%
325	74%	26%	0%	55%	45%	0%	76%	24%	0%	69%	31%	0%
330	75%	25%	0%	56%	44%	0%	78%	22%	0%	70%	30%	0%
335	75%	25%	0%	56%	44%	0%	78%	22%	0%	70%	30%	0%
340	77%	23%	0%	57%	43%	0%	79%	21%	0%	71%	29%	0%
345	77%	23%	0%	57%	43%	0%	79%	21%	0%	71%	29%	0%
350	77%	23%	0%	57%	43%	0%	79%	21%	0%	71%	29%	0%
355	80%	20%	0%	63%	37%	0%	82%	18%	0%	75%	25%	0%
360	80%	20%	0%	63%	37%	0%	82%	18%	0%	75%	25%	0%
365	81%	19%	0%	65%	35%	0%	83%	17%	0%	76%	24%	0%
370	81%	19%	0%	65%	35%	0%	83%	17%	0%	76%	24%	0%
375	81%	19%	0%	65%	35%	0%	83%	17%	0%	76%	24%	0%
380	83%	17%	0%	68%	32%	0%	86%	14%	0%	79%	21%	0%
385	83%	17%	0%	68%	32%	0%	86%	14%	0%	79%	21%	0%
390	85%	15%	0%	70%	30%	0%	87%	13%	0%	81%	19%	0%
395	85%	15%	0%	70%	30%	0%	87%	13%	0%	81%	19%	0%
400	85%	15%	0%	70%	30%	0%	87%	13%	0%	81%	19%	0%
405	87%	12%	1%	74%	26%	0%	89%	11%	0%	83%	16%	0%
410	87%	12%	1%	74%	26%	0%	89%	11%	0%	83%	16%	0%
415	89%	10%	1%	75%	25%	0%	89%	10%	1%	84%	15%	1%
420	89%	10%	1%	75%	25%	0%	89%	10%	1%	84%	15%	1%
425	89%	10%	1%	75%	25%	0%	89%	10%	1%	84%	15%	1%
430	90%	9%	1%	75%	24%	0%	91%	8%	1%	85%	14%	1%
435	90%	9%	1%	76%	24%	0%	91%	8%	1%	86%	14%	1%
440	90%	9%	1%	78%	21%	0%	91%	8%	1%	87%	13%	1%
445	90%	9%	1%	78%	21%	0%	91%	8%	1%	87%	13%	1%
450	90%	9%	1%	78%	21%	0%	91%	8%	1%	87%	13%	1%
455	90%	7%	3%	80%	20%	0%	92%	7%	1%	87%	11%	1%
460	90%	7%	3%	80%	20%	0%	92%	7%	1%	87%	11%	1%
465	90%	6%	4%	80%	18%	1%	93%	5%	1%	88%	10%	2%
470	90%	6%	4%	80%	18%	1%	93%	5%	1%	88%	10%	2%
475	90%	6%	4%	80%	18%	1%	93%	5%	1%	88%	10%	2%
480	89%	5%	6%	80%	17%	2%	94%	4%	3%	88%	9%	4%
485	89%	5%	6%	80%	17%	2%	94%	4%	3%	88%	9%	4%

Table B7 (cont'd). Full contingency table for seated power throw for OPAT recruits.

	Common MOSs			13B			19K			Combined		
Distance (cm)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
490	88%	5%	7%	82%	15%	3%	93%	4%	3%	87%	8%	5%
495	88%	5%	7%	82%	15%	3%	93%	4%	3%	87%	8%	5%
460	90%	7%	3%	80%	20%	0%	92%	7%	1%	87%	11%	1%
465	90%	6%	4%	80%	18%	1%	93%	5%	1%	88%	10%	2%
470	90%	6%	4%	80%	18%	1%	93%	5%	1%	88%	10%	2%
475	90%	6%	4%	80%	18%	1%	93%	5%	1%	88%	10%	2%
480	89%	5%	6%	80%	17%	2%	94%	4%	3%	88%	9%	4%
485	89%	5%	6%	80%	17%	2%	94%	4%	3%	88%	9%	4%
490	88%	5%	7%	82%	15%	3%	93%	4%	3%	87%	8%	5%
495	88%	5%	7%	82%	15%	3%	93%	4%	3%	87%	8%	5%
500	88%	5%	7%	82%	15%	3%	93%	4%	3%	87%	8%	5%
505	87%	4%	9%	84%	11%	5%	90%	3%	7%	87%	6%	7%
510	87%	4%	9%	84%	11%	5%	90%	3%	7%	87%	6%	7%
515	86%	4%	10%	83%	10%	7%	88%	3%	9%	86%	5%	9%
520	86%	4%	10%	83%	10%	7%	88%	3%	9%	86%	5%	9%
525	86%	4%	10%	83%	10%	7%	88%	3%	9%	86%	5%	9%
530	82%	3%	15%	81%	10%	9%	83%	3%	15%	82%	5%	13%
535	82%	3%	15%	81%	10%	9%	83%	3%	15%	82%	5%	13%
540	81%	2%	16%	80%	9%	11%	80%	2%	18%	81%	4%	15%
545	81%	2%	16%	80%	9%	11%	80%	2%	18%	81%	4%	15%
550	81%	2%	16%	80%	9%	11%	80%	2%	18%	81%	4%	15%
555	78%	2%	21%	78%	7%	15%	74%	1%	25%	77%	3%	20%
560	78%	2%	21%	78%	7%	15%	74%	1%	25%	77%	3%	20%
565	76%	1%	23%	77%	7%	16%	71%	1%	27%	75%	3%	22%
570	76%	1%	23%	77%	7%	16%	71%	1%	27%	75%	3%	22%
575	76%	1%	23%	77%	7%	16%	71%	1%	27%	75%	3%	22%
580	71%	1%	29%	75%	3%	22%	66%	1%	33%	71%	1%	28%
585	71%	1%	29%	75%	3%	22%	66%	1%	33%	71%	1%	28%
590	68%	1%	32%	71%	2%	27%	63%	1%	36%	68%	1%	31%
595	68%	1%	32%	71%	2%	27%	63%	1%	36%	68%	1%	31%
600	68%	1%	32%	71%	2%	27%	63%	1%	36%	68%	1%	31%
605	62%	0%	38%	66%	2%	32%	54%	1%	45%	61%	1%	38%
610	62%	0%	38%	66%	2%	32%	54%	1%	45%	61%	1%	38%
615	59%	0%	40%	63%	1%	36%	51%	0%	48%	58%	1%	41%
620	59%	0%	40%	63%	1%	36%	51%	0%	48%	58%	1%	41%
625	59%	0%	40%	63%	1%	36%	51%	0%	48%	58%	1%	41%
630	55%	0%	45%	61%	1%	38%	47%	0%	52%	55%	1%	45%
635	55%	0%	45%	61%	1%	38%	47%	0%	52%	55%	1%	45%

Table B7 (cont'd). Full contingency table for seated power throw for OPAT recruits.

	Common MOSs			13B			19K			Combined		
Distance (cm)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
640	52%	0%	48%	59%	1%	40%	44%	0%	56%	52%	0%	48%
645	52%	0%	48%	59%	1%	40%	44%	0%	56%	52%	0%	48%
650	52%	0%	48%	59%	1%	40%	44%	0%	56%	52%	0%	48%
655	48%	0%	51%	56%	1%	43%	38%	0%	62%	48%	0%	52%
660	48%	0%	51%	56%	1%	43%	38%	0%	62%	48%	0%	52%

Table B8. Full contingency table for strength deadlift for OPAT recruits.

	Common MOSs			13B			19K			Combined		
Load (lbs.)	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
0	74%	26%	0%	52%	48%	0%	76%	24%	0%	67%	33%	0%
60	74%	26%	0%	52%	48%	0%	76%	24%	0%	67%	33%	0%
100	74%	26%	0%	52%	48%	0%	76%	24%	0%	67%	33%	0%
140	76%	24%	0%	55%	45%	0%	78%	21%	0%	70%	30%	0%
180	83%	16%	1%	68%	31%	0%	83%	16%	1%	78%	21%	1%
220	88%	5%	7%	80%	19%	2%	90%	4%	6%	86%	9%	5%

Table B9. Full contingency table for interval aerobic run for OPAT recruits.

	Common MOSs			13B			19K			Combined		
Shuttles	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
10	74%	26%	0%	52%	48%	0%	76%	24%	0%	67%	33%	0%
11	74%	26%	0%	52%	48%	0%	76%	24%	0%	67%	33%	0%
12	74%	26%	0%	52%	48%	0%	76%	24%	0%	67%	33%	0%
13	74%	26%	0%	52%	48%	0%	76%	24%	0%	68%	32%	0%
14	74%	26%	0%	53%	47%	0%	77%	23%	0%	68%	32%	0%
15	75%	25%	0%	53%	47%	0%	78%	22%	0%	69%	31%	0%
16	76%	24%	0%	54%	46%	0%	79%	21%	0%	70%	30%	0%
17	76%	24%	0%	54%	46%	0%	79%	21%	0%	70%	30%	0%
18	77%	23%	0%	54%	46%	0%	79%	21%	0%	70%	30%	0%
19	77%	23%	0%	55%	45%	0%	79%	21%	0%	71%	29%	0%
20	77%	23%	0%	55%	45%	0%	80%	20%	0%	71%	29%	0%
21	77%	23%	0%	55%	45%	0%	80%	20%	0%	71%	29%	0%
22	78%	22%	0%	55%	45%	0%	80%	20%	0%	71%	29%	0%
23	78%	22%	0%	56%	44%	0%	81%	19%	0%	72%	28%	0%
24	79%	21%	0%	57%	43%	0%	81%	19%	0%	72%	27%	0%
25	80%	20%	0%	59%	40%	0%	81%	17%	2%	73%	26%	1%
26	80%	20%	0%	59%	40%	1%	80%	17%	2%	73%	26%	1%
27	80%	19%	1%	60%	40%	1%	81%	16%	2%	74%	25%	1%
28	80%	19%	1%	60%	39%	1%	81%	16%	2%	74%	25%	1%
29	81%	18%	1%	60%	39%	1%	82%	16%	2%	75%	24%	1%
30	81%	18%	1%	62%	37%	1%	82%	16%	3%	75%	23%	2%
31	81%	17%	2%	62%	37%	1%	82%	15%	3%	75%	23%	2%
32	81%	17%	2%	62%	36%	2%	82%	15%	4%	75%	23%	2%
33	81%	17%	2%	62%	36%	2%	82%	13%	5%	75%	22%	3%
34	82%	15%	3%	63%	33%	3%	79%	12%	9%	75%	20%	5%
35	81%	14%	4%	64%	32%	3%	80%	11%	9%	75%	19%	5%
36	80%	14%	5%	64%	32%	4%	78%	11%	11%	75%	19%	6%
37	79%	14%	6%	65%	31%	4%	79%	10%	12%	75%	18%	7%
38	81%	13%	6%	67%	29%	4%	80%	8%	12%	76%	17%	7%
39	81%	13%	6%	67%	28%	5%	79%	8%	13%	76%	17%	8%
40	79%	13%	8%	68%	27%	6%	79%	8%	13%	75%	16%	9%
41	80%	12%	8%	68%	25%	7%	78%	8%	14%	76%	15%	9%
42	80%	12%	8%	69%	24%	7%	76%	8%	16%	75%	15%	10%
43	79%	10%	12%	70%	22%	9%	74%	6%	21%	74%	12%	13%
44	79%	9%	12%	70%	20%	10%	72%	5%	22%	74%	12%	14%
45	78%	8%	14%	69%	20%	12%	72%	5%	23%	73%	11%	16%
46	76%	8%	16%	69%	19%	12%	70%	4%	26%	72%	10%	18%
47	75%	8%	17%	69%	17%	13%	68%	4%	28%	71%	10%	19%

Table B9 (continued). Full contingency table for interval aerobic run for OPAT recruits.

	Common MOSs			13B			19K			Combined		
Shuttles	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
48	74%	8%	18%	68%	17%	14%	66%	4%	30%	70%	10%	20%
49	74%	7%	19%	69%	17%	15%	65%	4%	31%	70%	9%	21%
50	73%	7%	20%	69%	16%	15%	63%	4%	32%	69%	9%	22%
51	72%	6%	21%	67%	15%	17%	62%	4%	35%	68%	9%	24%
52	72%	6%	22%	67%	15%	18%	61%	3%	36%	67%	8%	25%
53	70%	5%	26%	67%	12%	22%	58%	3%	40%	65%	7%	28%
54	68%	5%	27%	67%	11%	22%	57%	3%	41%	65%	6%	29%
55	66%	5%	29%	67%	10%	23%	55%	3%	42%	63%	6%	31%
56	63%	5%	32%	66%	10%	24%	53%	3%	44%	62%	6%	32%
57	62%	4%	34%	67%	9%	25%	53%	2%	45%	61%	5%	34%
58	62%	4%	34%	66%	8%	25%	51%	2%	47%	60%	5%	35%
59	59%	4%	37%	67%	7%	26%	50%	2%	47%	59%	5%	36%
60	58%	4%	38%	65%	7%	28%	49%	2%	48%	58%	4%	37%
61	56%	4%	40%	65%	7%	28%	49%	2%	49%	57%	4%	39%
62	56%	3%	41%	66%	6%	28%	49%	2%	49%	57%	4%	39%
63	54%	2%	44%	64%	5%	31%	47%	0%	53%	55%	3%	42%
64	53%	2%	45%	63%	5%	32%	45%	0%	55%	54%	2%	44%
65	52%	2%	46%	63%	4%	33%	44%	0%	56%	54%	2%	44%
66	51%	2%	47%	62%	3%	35%	42%	0%	58%	52%	2%	46%
67	50%	2%	48%	63%	3%	35%	42%	0%	58%	52%	2%	46%
68	49%	2%	49%	62%	3%	35%	40%	0%	60%	51%	2%	48%
69	48%	2%	50%	62%	3%	36%	40%	0%	60%	50%	2%	48%
70	47%	2%	52%	62%	2%	37%	39%	0%	61%	50%	1%	49%
71	46%	2%	53%	61%	2%	37%	39%	0%	61%	49%	1%	50%
72	44%	2%	54%	60%	2%	38%	37%	0%	63%	48%	1%	51%
73	43%	2%	56%	60%	1%	39%	37%	0%	63%	47%	1%	52%
74	41%	2%	58%	59%	1%	40%	35%	0%	65%	45%	1%	54%
75	39%	1%	59%	58%	1%	41%	34%	0%	66%	44%	1%	55%
76	39%	1%	60%	58%	1%	41%	33%	0%	67%	44%	1%	56%
77	38%	1%	61%	57%	1%	42%	32%	0%	68%	43%	1%	56%
78	38%	1%	62%	57%	1%	43%	32%	0%	68%	42%	0%	57%
79	37%	1%	62%	57%	1%	43%	32%	0%	68%	42%	0%	58%
80	37%	1%	63%	56%	1%	43%	32%	0%	68%	41%	0%	58%
81	36%	1%	64%	56%	1%	43%	30%	0%	70%	41%	0%	59%
82	35%	1%	64%	55%	1%	44%	30%	0%	70%	40%	0%	59%
83	35%	1%	64%	55%	1%	44%	30%	0%	70%	40%	0%	59%
84	34%	0%	65%	55%	0%	45%	30%	0%	70%	40%	0%	60%
85	34%	0%	66%	55%	0%	45%	27%	0%	73%	39%	0%	61%

Table B9 (continued). Full contingency table for interval aerobic run for OPAT recruits.

	Common MOSs			13B			19K			Combined		
Shuttles	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail	Correct	False Pass	False Fail
86	33%	0%	67%	54%	0%	45%	27%	0%	73%	38%	0%	62%
87	33%	0%	67%	54%	0%	46%	26%	0%	74%	38%	0%	62%
88	32%	0%	68%	53%	0%	47%	26%	0%	74%	37%	0%	63%
89	31%	0%	69%	52%	0%	47%	26%	0%	74%	37%	0%	63%
90	31%	0%	69%	52%	0%	47%	25%	0%	75%	36%	0%	64%
91	30%	0%	70%	52%	0%	48%	25%	0%	75%	36%	0%	64%
92	30%	0%	70%	52%	0%	48%	25%	0%	75%	36%	0%	64%
93	30%	0%	70%	52%	0%	48%	25%	0%	75%	35%	0%	65%
94	30%	0%	70%	51%	0%	49%	25%	0%	75%	35%	0%	65%
95	30%	0%	70%	51%	0%	49%	25%	0%	75%	35%	0%	65%
96	29%	0%	71%	50%	0%	50%	25%	0%	75%	35%	0%	65%
97	28%	0%	72%	50%	0%	50%	25%	0%	75%	34%	0%	66%
98	28%	0%	72%	50%	0%	50%	25%	0%	75%	34%	0%	66%
99	27%	0%	73%	50%	0%	50%	25%	0%	75%	34%	0%	66%
100	27%	0%	73%	50%	0%	50%	25%	0%	75%	34%	0%	66%

Table B10. Comparison CMTS performance for fully trained PDS Soldiers and OPAT study new recruits by Military Occupational Specialty (estimated mean \pm standard error)

Task and MOS	PDS		OPAT		p-value for PDS vs OPAT	MOS Main effect
Roadmarch (min)	n	Mean \pm SE	n	Mean \pm SE	p-value	Mean \pm SE
11B	94	76.9 \pm 0.7	63	65.7 \pm 0.8	p < 0.01	71.3 \pm 0.6 ^a
11C	86	76.7 \pm 0.7	40	64.3 \pm 1.1	p < 0.01	70.5 \pm 0.6 ^b
12B	96	75.7 \pm 0.7	69	63.7 \pm 0.8	p < 0.01	69.7 \pm 0.5 ^{b,c}
13F	76	72.3 \pm 0.8	23	66.9 \pm 1.4	p < 0.01	69.6 \pm 0.8 ^{a,b,c}
19D	85	74.9 \pm 0.7	63	61.6 \pm 0.8	p < 0.01	68.2 \pm 0.6 ^d
19K	94	78.2 \pm 0.7	176	68.3 \pm 0.5	p < 0.01	73.2 \pm 0.4 ^e
Sandbag Carry (min)	n	Mean \pm SE	n	Mean \pm SE	p-value	Mean \pm SE
11B	94	1.7 \pm 0.04	61	1.9 \pm 0.04	p < 0.01	1.8 \pm 0.03 ^a
11C	86	1.7 \pm 0.04	44	2.1 \pm 0.05	p < 0.01	1.9 \pm 0.03 ^b
12B	96	1.7 \pm 0.04	73	2.0 \pm 0.04	p < 0.01	1.8 \pm 0.03 ^c
13F	76	1.9 \pm 0.04	23	2.4 \pm 0.07	p < 0.01	2.1 \pm 0.04 ^d
19D	85	1.7 \pm 0.04	65	2.1 \pm 0.04	p < 0.01	1.9 \pm 0.03 ^{b,c}
Casualty Drag (m·sec ⁻¹)	n	Mean \pm SE	n	Mean \pm SE	p-value	Mean \pm SE
11B	94	1.1 \pm 0.03	61	0.9 \pm 0.04	p < 0.01	1.03 \pm 0.03 ^a
11C	86	1.1 \pm 0.04	44	0.7 \pm 0.05	p < 0.01	0.90 \pm 0.03 ^b
12B	96	1.2 \pm 0.03	76	0.7 \pm 0.04	p < 0.01	0.94 \pm 0.02 ^b
13B	77	1.2 \pm 0.03	185	0.6 \pm 0.02	p < 0.01	0.91 \pm 0.02 ^b
13F	76	1.2 \pm 0.03	23	0.8 \pm 0.06	p < 0.01	0.96 \pm 0.04 ^{a,b}
19D	85	1.2 \pm 0.03	65	0.8 \pm 0.04	p < 0.01	0.96 \pm 0.03 ^b
19K	94	1.1 \pm 0.03	192	0.8 \pm 0.02	p < 0.01	0.95 \pm 0.02 ^b
Casualty Evacuation (lb)	n	Mean \pm SE	n	Mean \pm SE	p-value	Mean \pm SE
11B	94	208.8 \pm 2.6	61	176.2 \pm 3.3	p < 0.01	192.5 \pm 2.1 ^a
11C	86	207.7 \pm 2.7	44	190.9 \pm 3.8	p < 0.01	199.3 \pm 2.4 ^b
12B	96	201.7 \pm 2.6	76	191.2 \pm 3.0	p = 0.01	196.5 \pm 2.0 ^{a,b}
13F	76	185.9 \pm 2.9	23	177.8 \pm 5.3	p = 0.18	181.9 \pm 3.0 ^c
19D	85	208.4 \pm 2.8	65	190.8 \pm 3.2	p < 0.01	199.6 \pm 2.1 ^b
19K	94	206.8 \pm 2.6	193	191.9 \pm 1.8	p < 0.01	199.4 \pm 1.6 ^b
Move Under Fire (min)	n	Mean \pm SE	n	Mean \pm SE	p-value	Mean \pm SE
11B	94	2.3 \pm 0.02	61	2.2 \pm 0.02	p < 0.05	2.3 \pm 0.02 ^a
11C	86	2.3 \pm 0.02	44	2.3 \pm 0.03	p < 0.05	2.3 \pm 0.02 ^b
13F	76	2.2 \pm 0.02	23	2.2 \pm 0.04	p < 0.05	2.2 \pm 0.02 ^c
19D	85	2.2 \pm 0.02	65	2.3 \pm 0.02	p < 0.05	2.3 \pm 0.02 ^{a,b}
19K	94	2.2 \pm 0.02	192	2.4 \pm 0.01	p < 0.05	2.3 \pm 0.01 ^{a,b}

^a Different letters indicate significant differences between means for MOS.

Roadmarch MOS main effect: 12B faster than 11B, 19D Faster than 11B, 11C, 12B and 19K, 19K slower than all

Sandbag Carry MOS main effect: 11B faster than 11C, 13F, 19D

Casualty Drag MOS main effect: 11B faster than 11C, 12B, 13B, 19D and 19K.

Casualty Evacuation MOS main effect: 11B < 11C, 13F, 19D, 19K. 13F < all others.

Move Under Fire MOS main effect: 11B faster than 11C, 13F. 13F slower than all others.

Table B11. Comparison of CMTS performance of MOS-specific tasks for fully trained PDS Soldiers and OPAT study new recruits (mean \pm standard error).

Task and MOS	PDS		OPAT		p-value
	n	Mean \pm SE	n	Mean \pm SE	
FAASV (rounds \cdot min ⁻¹) 13B	77	4.2 \pm 1.2	191	3.1 \pm 1.4	p = 0.07
Stow Ammunition (min) 19K	94	7.6 \pm 1.3	192	7.1 \pm 1.6	p = 0.95
Load Main gun (sec) 19K	94	16.6 \pm 2.7	193	21.3 \pm 4.3	p < 0.01

Table B12. Comparison of adverse impact on women for the Physical Demands Study versus the OPAT Study on individual OPAT events and CMTSs.

	Physical Demands Study % Women Passing % Men Passing	OPAT Study % Women Passing % Men Passing
Standing Long Jump	52%	32%
Seated Power Throw	26%	15%
Strength Deadlift	47%	57%
Interval Aerobic Run	52%	34%
Foot march <i>min</i>*	93%	100%
Sandbag Carry <i>min</i>*	100%	100%
Move Under Fire <i>min</i>*	100%	100%
Casualty Evacuation <i>lbs.</i>	78%	35%
Casualty Drag <i>m·s⁻¹</i>	64%	19%
FAASV <i>rounds/min</i>	29%	16%
Load Main Gun <i>sec</i>*	93%	96%
Stow Ammo <i>rounds/min</i>	78%	78%

*The percentage for timed events is inverted as shorter times are a better score than longer times.

Appendix C.

Standing Long Jump Instructions:

The purpose of the standing long jump is to assess lower-body power. You will stand behind the take-off line with your feet parallel and shoulder-width apart. You will jump as far as possible with a two-foot take-off and landing. You are allowed to rock on your toes and heels, but the feet cannot be raised off the surface before the jump. The jump begins by moving both arms forward and backward (counter-movement) while bending at the knees and hips. On landing, absorb the shock by bending the knees and hips. Do not move your feet after landing, in other words, 'stick' the landing. If you fall, or move your feet forward, you may be asked to repeat the attempt. If you fall backward you will have to repeat the jump. You will perform two practice jumps followed by three maximum effort jumps that will be recorded.

Watch this demonstration.

Do you have any questions about this test?

Seated Power Throw Instructions:

The purpose of the seated power throw is to assess upper-body power. During the test, you will sit on the floor with your lower back against the yoga block and upper back against the wall. Your legs should be extended straight out in front of you with your feet together. You will hold the medicine ball with two hands. When I say go, bring the medicine ball to your chest. You will pause briefly, then push/throw the medicine ball upwards and outwards at a 45-degree angle. To maximize the distance of the throw, follow through by flexing your wrists. Do not throw the medicine ball like shooting a basketball, one arm should not overpower the other. The distance of your throw will be measured from the wall to the landing point of the medicine ball. You will be given two practice throws. After the practice throws, you will be asked to complete three maximal effort throws for record. While throwing the medicine ball, you must keep your upper back against the wall and lower back against the yoga block. If you fail to maintain contact with the wall, you will be asked to repeat the throw.

“Watch this demonstration.”

“Do you have any questions about this test?”

Strength Deadlift Instructions:

The purpose of the strength deadlift is to assess lower-body strength. Beginning with only the unloaded barbell, you will squat down, grasp the handles, and complete a set of 3 deadlifts (as a warm-up and to ensure use of proper form). You will begin by standing inside the open space of the barbell with your feet about shoulder-width apart. Make sure your knees are in line with your toes, bend at the hips and knees, sticking your buttocks back so that your back is flat or slightly arched. Keep your head in a neutral position throughout the lift. Grip the handles at your sides with arms fully extended or slightly bent. When I say “ready, lift,” lift the barbell straight up by extending your knees and hips at the same time. Your head and shoulders should remain above the hips at all times. Your arms should remain extended. When you are standing with your hips and knees fully straight, the test administrator will say “good.” You will then squat back down and place the barbell on the ground in a safe and controlled manner (without dropping the barbell). If you show poor lifting technique, you will be stopped and you will not receive credit for that weight.

After you have successfully lifted the barbell unloaded, you will be given a short rest. The next weight you will lift in the sequence is 100-lb, 140- lbs., 180-lb, and 220-lb loaded barbells. You will complete one deadlift using proper technique at progressively heavier weights. You may not skip a weight in the sequence described. You will rest for up to 1 minute after each lift. If you fail to successfully complete a lift, you may try one more time after you rest 1 minute. Don’t over-exert yourself trying to lift a weight that is too heavy. If you feel any pain or discomfort, you should put the barbell down and stop performing the lift.

“Watch this demonstration.”

“Do you have any questions about this test?”

Beep Test Instructions:

The purpose of the interval aerobic run, or beep test, is to assess aerobic capacity. You will jog, run, and then sprint between two lines 20 meters apart in time to recorded beeps. To get an accurate score, you must keep going until you are no longer able to keep the pace. You will stand behind one of the lines to start and face the second line. You will begin jogging when instructed by the recording. The test starts with a slow jog to warm up. You will jog between the two lines when signaled by the beeps. You should arrive at the line just before the next beep. Do not run faster than necessary during the early stages. After about 1 minute, a sound will indicate an increase in speed, and the beeps will be closer together, so you will have to run a little faster. This continues each minute/level. You must cross the opposite line with one foot before the beep sounds. If you get to the line before the beep, you cannot begin running back before the beeps sounds. If you do not make it to the end line before the beep, you will be warned (example: “warning #1”; “warning #2”, “stop”). When you fail to make it over the end line before the beep three times in a row, you will be told to stop. If you fail to reach the line one or two times in a row, and then successfully reach the line, the count for warnings will start at one again. At any point, you may choose to stop on your own, if you do not feel you can continue.

“Watch this demonstration.”

“Do you have any questions about this test?”

Appendix D.

D1. CMTSs Uniform Loads

Basic Uniform:

Items	Weight (lbs.)
ACUs	3.20
Boots	5.00
Rigger Belt	0.50
Patches	0.49
Patrol Cap	0.48
ID Tags	0.38
Undershirt	0.35
Eye Pro	0.25
Notebook	0.25
Drawers	0.20
Socks	0.20
Wrist Watch	0.19
Ear Plugs	0.13
Chap stick	0.01
ID Card	0.01
Total	11.64 lbs.

D1 (continued). CMTSs Uniform Loads

PPE and Weapon

Items	Weight (lbs.)
100 oz. Hydration system (with water)	7.10
Fighting Load Carrier	1.25
30 round magazine pouch (3 x 0.25)	0.75
Hand grenade pouch (2) w/ (2) M67 Fragmentation Grenades	1.86
Lensatic Compass with case	0.27
Individual First Aid Kit (IIFAK)	1.08
Mag light flashlight w/2 each AA battery	0.24
Infrared signal beacon, PHOENIX w/battery	0.70
Ballistic Knee/Elbow Pads	0.79
Visual/Language Translator Card	0.01
Casualty Feeder Report/ Witness Statement	0.01
Advanced Combat Helmet (ACH)	3.25
Helmet Cover w/ camouflage cover band	0.28
Night Vision goggle mounting plate	0.20
Ballistic Protection Goggles (ESS)	0.15
<i>*M4 Carbine w/fully loaded magazine*</i>	<i>*7.50*</i>
<i>*M68- CCO w/battery*</i>	<i>*0.71*</i>
<i>*3 point sling*</i>	<i>*0.30*</i>
<i>*Back-Up Iron Sight*</i>	<i>*0.32*</i>
<i>*M-4 RAS & Forward Pistol Grip*</i>	<i>*1.55*</i>
5.56-mm Magazine with 30 rounds each (6 each)	6.42
<i>*Sure Fire light with battery*</i>	<i>*0.50*</i>
<i>*PAQ-4C with batteries*</i>	<i>*0.90*</i>
Total	36.14 lbs.
IOTV with neck/groin protector	11.69-19.63
Enhanced Small Arms Protective Inserts	7.60-14.20
Enhanced Side Ballistic Insert set with Side Plate Carrier	7.60
GRAND Total	63.03 to 77.57 lbs.

Italics indicates weapon components that would not be included for the fighting load without weapon uniform

D1 (continued). CMTSs Uniform Loads

Infantry School Specified Load for Foot March

Basic Uniform:

Items	Weight (lbs.)
ACUs	3.20
Boots	5.00
Rigger Belt	0.50
Patches	0.49
Patrol Cap	0.48
ID Tags	0.38
Undershirt	0.35
Eye Pro	0.25
Notebook	0.25
Drawers	0.20
Socks	0.20
Wrist Watch	0.19
Ear Plugs	0.13
Chap stick	0.01
ID Card	0.01
Total	11.64 lbs.

Weapons and Tactical Equipment:

Items	Weight (lbs.)
ACH With Cover	3.53
100oz Hydration System	7.1
FLC	5.87
Elbow/Knee Pads	0.79
M4 W/PEQ-15 & M68 CCO	7.34
Total	24.63 lbs.

Foot March Load:

Items	Weight (lbs.)
11B10 Basic Uniform	11.64
Weapon and Tactical Equipment	24.63
MOLLE Rucksack	33
GRAND Total	69.27 lbs.

D1 (continued). CMTSs Uniform Loads

Fighting Load with Weapon

(Tasks: Casualty Drag, Move Under Fire)

Items	Weight (lbs.)
Basic Uniform	11.64
PPE + Weapon	63.03 to 77.57
Total	74.67 to 89.21 lbs.

Fighting Load without Weapon

(Tasks: Sandbag Carry, Casualty Evacuation, Stow Ammo)

Items	Weight (lbs.)
Basic Uniform	11.64
PPE (without weapon)	51.03 to 66.6
Total	62.67 to 78.24 lbs.

Task-Specific Load

(Tasks: Load Main Gun, Transfer Ammo with a FAASV)

Items	Weight (lbs.)
Basic Uniform	11.64
ACH	3.25
IOTV, w/ESAPI and ESBI	26.89 to 41.43
Total	41.78 to 56.32 lbs.

D2. CMTSs Instructions

Conduct a Tactical Movement (Foot March)

Uniform: Infantry School specified Foot March load

The purpose of the test is to determine how quickly you can walk 4 miles while wearing a total load of 70 lb. You will walk four miles as fast as possible without running or doing the airborne shuffle. Your weapon should be held at ready in front of you at all times. You will be issued a timing device and place a volunteer number on your helmet. Prior to entering the course, you will punch your timing stick into the start receptacle. This will start the timer. Follow the marked off course [*describe the course and markings*]. Walk between the set of cones on the right hand side of the trail at each mile mark to record your split for that mile. There will be test administrators along the course to monitor and ensure you are ok and not running. You can rest as needed, but try to finish as quickly as possible. If you need to stop at any point, send another soldier to notify the nearest test administrator along the course. When you cross the finish line, approach one of the test administrators who will record your name and time and retrieve your timing device.

Do you have any questions about this test?

Sandbag Carry

Uniform: Fighting load without weapon

The purpose of this task is to determine how quickly you can carry 16 filled sandbags 10 meters to build a fighting position. You will start behind the 10 meter line on the opposite side of the sandbags. When I say go, you will carry a total of 16 sandbags 10 meters where you will build a fighting position that is 4 sandbags wide, 2 sandbags deep, and two sandbags tall. You may carry no more than 2 sandbags at a time, and you must properly place the sandbags you are carrying within the marked outline before returning for the next bag. Upon completion your finish time will be recorded.

Watch this demonstration.

Do you have any questions about this test?

Move Under Fire

Uniform: Fighting load with weapon

The purpose of this task is to determine your ability to move under fire. You will begin the test lying in an unsupported prone fighting position (on your stomach). When told to begin, you will rise and sprint to the first marker. Get right next to the marker and assume a kneeling fighting position. After 5 seconds, we will cue you to run to the next marker. You will sprint, get right next to the 2nd marker, and again assume a kneeling fighting position. You will continue sprinting between markers in a similar manner, cycling between 1 prone, and 2 kneeling positions, until you have completed the entire course. The signs next to each cone will instruct you whether to kneel or get prone. When getting up, you may not use the barrel of the gun for support. On the final sprint, run straight through the finish line.

You should perform the task as quickly as possible while maintaining your safety, but choose a pace at which you can complete the task. Once you start the test, do not stop unless it is an emergency. You should continue even if you stumble. Upon completion of the task, your time will be recorded.

Watch this demonstration.

Do you have any questions about this test?

Casualty Evacuation

Uniform: Fighting load without weapon

The purpose of this task is to determine your ability to pull a simulated casualty from a vehicle. You will squat down, grasp the straps and pull the bag out through the hole simulating a vehicle hatch. You must lift the bag up and place it beside the hatch (either upright or on its side) for it to be considered successful. Make sure you are wearing gloves. Prior to starting we will review proper lifting technique with kettlebells/dumbbells/sandbags/etc. You will be required to use good technique on every lift to protect your lower back. If you show poor lifting technique, we will stop you and you will not receive credit for that weight. If you feel any pain or discomfort, you should release the weight and stop performing the task.

After you have completed the 60 lbs., the next weights you will lift is 100 lbs. followed by 140, 180, and 210 lbs. (all in that order). If you fail to successfully complete a lift, you may have one more opportunity to complete the lift after 1 min of rest. The maximum permitted weight to lift for this test is 210 lb. You are not allowed to skip any of the weights. Upon completion, your final lift weight will be recorded. After each successful lift, you will bring the bag back and drop it into the hole.

There should never be more than five people on the simulation deck at one time. The first person will walk up the stairs to the first weight, perform the lift, and move to the next weight. Once you have completed the task, you will exit down the stairs on the opposite end from which you entered.

Watch this demonstration.

Do you have any questions about this test?

Casualty Drag

Uniform: Fighting load with weapon

The purpose of this task is to determine how quickly you can drag a 270-lb casualty a distance of 15 meters. The instructions will be "3-2-1-go!" On this command, you will grasp the harness straps on the dummy with one or two hands and drag the dummy as quickly as possible past the 2nd set of cones. The feet of the dummy must cross the line before you stop, so don't stop until I tell you to. You will have 60 seconds to complete this task and i will count down the last 5 seconds and say 'stop'. If you cross the finish line within 60 seconds, I'll tell you when to stop. If you do not cross the finish line when i count down and say 'stop', stop right where you are and wait until i tell you to release the dummy. I will measure how far you dragged it. Your time and distance completed will be recorded.

Watch this demonstration.

Do you have any questions about this test?

Transfer Ammo with a FAASV

Uniform: Task-specific load

The purpose of this test is to determine your ability to load m795 he rounds into a field artillery ammunition supply vehicle or FAASV. Before beginning, make sure you are wearing gloves.

This task requires you to lift the rounds from the tailgate of the FAASV and place them in the ammunition rack in the specified slots. Prior to testing, we will check your height in the FAASV, since you will only be required to fill slots up to your shoulder height. You must carry the rounds; you may not roll them. You will have up to 20 min to move up to 30 rounds. The time will be split into three work shifts of 5 min, with a mandatory 2 ½ min rest in between each shift. I will provide warnings when time is running out in each shift. When I alert you that each shift is up, you must safely place the shell down at your current position. When the rest is over, you will resume from the position you left off.

You should perform the task as quickly as possible while maintaining your safety, but choose a pace at which you can complete the task. You can stop and rest as necessary. If you are unable to continue even after a break, tell the administrator, and we will terminate the test. Your finish time and total number of rounds moved will be recorded.

Watch this demonstration.

Do you have any questions about this test?

Load the Main Gun

Uniform: Task-specific load

The purpose of this task is to determine your ability to rapidly load 5 rounds into the main gun of an A1 Abrams tank. Before we begin, make sure you are wearing gloves.

Inside the Abrams tank simulator, you will move five 120-mm MPAT rounds. You will grab a round from the bustle rack, do a proper flip or turn, and then push the round into the simulated breach. After each round you will hit the button simulating the firing of the gun. You will then grab the next round and repeat this process until you have loaded all 5 rounds. Prior to starting, you will be given an opportunity to practice. Each soldier will complete 5 rounds and then go to the end of the line. You will complete the 5 rounds, 3 times.

You should perform the task as quickly as possible while maintaining your safety, but choose a pace at which you can complete the task. If at any point you feel you are unable to continue, the test will be terminated. Your time of completion will be recorded.

Watch this demonstration.

Do you have any questions about this test?

Stow Ammunition

Uniform: Fighting load without weapon

The purpose of this task is to determine your ability to reload an A1 Abrams tank. Before we begin, make sure you are wearing gloves. During this task, you will lift and carry 18 rounds 5 meters from the supply rack to the tank and lift the round onto the table. This simulates handing the round up to a soldier standing on the hull of the tank. While carrying the round, one hand should be over the aft-cap while the other is supporting the weight (*demonstrate*). When lifting the rounds at the table, you should do it in a safe manner. Do not throw them or slam them on the table. The round should be handed to the soldier behind the platform. You will have 15 min to complete this task, but should perform the task as quickly as possible while maintaining your safety. Choose a pace at which you can complete the task. You can rest at any time. If at any point you feel you are unable to continue, the test will be terminated. Your time of completion and total number of rounds moved will be recorded.

Watch this demonstration.

Do you have any questions about this test?